WEAPONRY LANDSCAPE

BY

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THESIS

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ABSTRACT

A weapon is a device used to cause damage to living beings, structures, or systems. Weapons are used to increase the effect and efficiency of activities such as hunting, law enforcement, and warfare. In a broader context, weapons could be interpreted as a method used to gain a strategic, material, or mental advantage over objects or others. It could be said that, where there is a will, there is a weapon. Weapons bring tremendous destruction to humans and nature in war zones and other conflict areas, such as disordered social, political situations and deteriorative environment conditions. This thesis frames a productive approach to destructive weapons in landscape contexts. Specifically, it investigates and proposes the application of redundant weapons as tools for modifying landscape surfaces in two contexts: central Detroit, Michigan, and Lake Chad in Central Africa.

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CHAPTER 1 INTRODUCTION

Power is the ability to get what one wants, while destructive power is the power to destroy. War and other violent conflicts are typical behaviors of destructive power, which make and perform threats (Boulding 1989). Such conflicts have been a leading thread and threat throughout human development. From "cold" weapons (i.e., those that do not involve explosive materials) to high-tech controlled one, lives are taken with no difficulty increasing ease and efficiency, especially after 1900. Appallingly, through the twenty-five biggest wars over the last century, no less than 190 million people were killed (Hambling 2005).

Beyond what it does to humans, destructive power produced by military weapons has a close formative relationship with landscape. It can change the landform through enormous energy and cause environmental pollution, especially when chemical weapons are used. Thus, when people talk about the connections between landscape and weapons, the conventional concern is about how to reduce or mitigate negative impacts on people and the environment, such as by restoring ecosystems, healing psychological or emotional traumas in the aftermath, or commemorating the suffering of the victims of warfare.

For example, the Garden of Forgiveness in Beirut, Lebanon, aims to cherish peace and facilitate psychological healing in a country still recovering from a fifteen-year religious civil war (1975 to 1990) as well as to support the social and economic reemergence of this city. The garden is a symbol of hope and unity. It straddles what was known during the civil war as the Green Line, the battle line across which much of the heaviest fighting took place. The Green Line separated

Muslim and Christian factions at that time. For that reason, the design of the Garden of Forgiveness thematizes peaceful and inspiring emotion, which can reflect faith and trust in the face of turbulence and desperation. People can gather strength and feel healing and forgiveness there (Figure 1.1). Moreover, the garden responds to the city context by integrating archaeological heritage, revealed through war-time destruction of surface buildings, with natural landscape, conveying a sense of cultural progress within thousands of years of history.

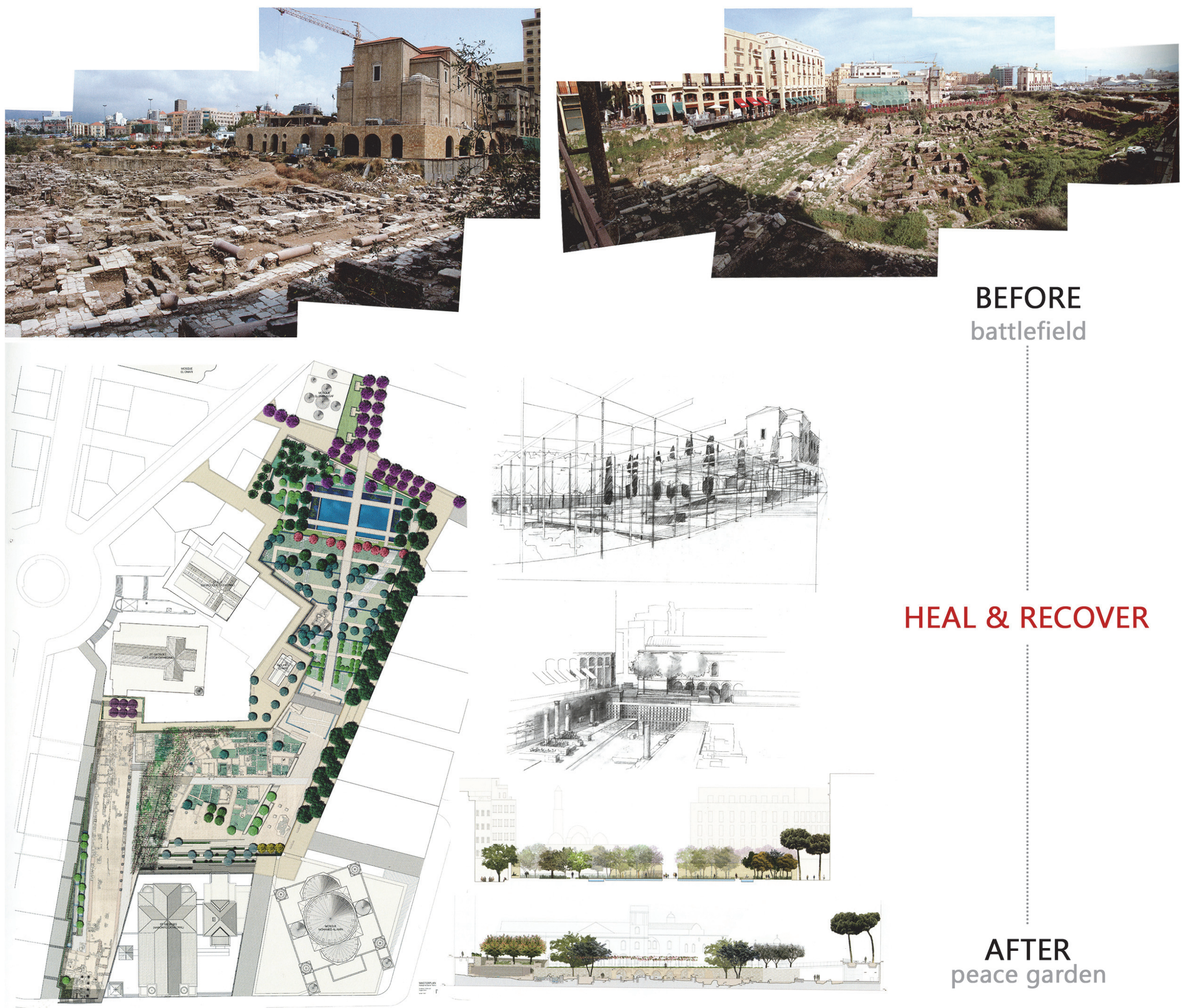


Figure 1.1 - Garden of Forgiveness, Beirut, Lebanon
Gustafson Porter

Every sort of power, including destructive power, has both positive and negative uses. For example, destructive power is used positively when a surgeon removes a tumor (Boulding 1989). Relative to landscape and conflict, practices such as Operation Plowshare (USA, 1961-1977) envisioned and tested positive uses of destructive nuclear blasts, a departure from the usual application. The project highlighted the peaceful applications of nuclear explosive devices for construction purposes. Non-combat uses for nuclear explosions included hard rock blasting, production stimulation of tight gas (natural gas locked deep in extremely impermeable and hard rock) (Law and Spencer 1993), geological mining, chemical element manufacturing, and exploring the Earth's deep crust. For example, 12 million tons of earth were displaced, creating a crater 1280 feet wide and 320 feet deep, in the 1962 "Sedan" plowshares blasting, which tested whether nuclear explosions could be used for excavation in civil engineering construction. Four years earlier, Project Chariot (1958) included plans to use five thermonuclear explosions to create an artificial harbor at Cape Thompson, Alaska (Information Office of Scientific & Technical n.d.) (Figure 1.2). Compared with conventional engineering process, this destructive power exploration is Jacobinical while efficient.

Storax Sedan explosion, Nevada National Security Site, 1962

Project Chariot Proposal, Cape Thompson, Alaska, 1958

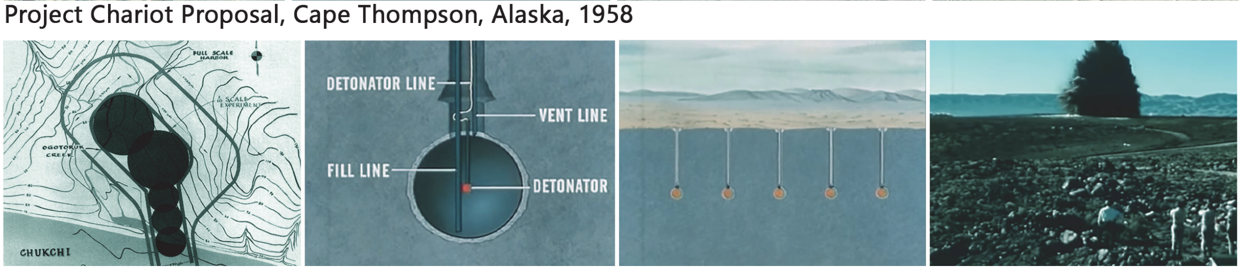


Figure 1.2 - Operation Plowshare
Top: Storax Sedan explosion, 1962
Bottom: Project Chariot Proposal, 1958

Inspired by the interpretations of the relationship between landscape and destructive power in these projects, this thesis builds an innovative reinterpretation of landscape transformation, conceives an ambitious approach to landscape modification especially when conventional manipulations are unsatisfactory, and reconsiders the complexity and interdependency between nature and man-made environment. The relationship between destructive power and landscape is just like the interpretation of war and space: rational and imaginative, precise and perceived, systematic and arbitrary (Boyd and Denis 2013). For this reason, it speculates destructive power as a guided and formative instrument and medium through which to pursue an open-ended landscape with boundless possibility. As a consequence, I propose peaceful access to available redundant weapons as a productive application of destructive power, redirecting those weapons from their originally intended purpose of murdering and dominating. Instead, these obtainable weapons will be used as an efficient tool to transform landscape conditions precisely and to accelerate social and ecological development—for example, by expediting the revitalization of economically depressed cities or by supporting reestablishment of ecosystem structure and function.

Rapid national defense development expedites weapon reform, renewal, and overstock. Consequently generational change is frequent and a large portion of weaponry is produced but not actually used. After being manufactured in arms factories, weapons are distributed to different areas either in peace or in war. In peaceful areas, they are applied to conventional national defense development, military training, and law enforcement, while in turbulent areas, they are applied to destructive purposes such as killing people, occupying territory, and plundering resources. In both situations, most of these massively overproduced weapons are stockpiled. For normal military procedure, most of them eventually need to be decommissioned or sealed after their service period.

After security processing of those weapons, a part of them float on the display and decoration market, and others with plenty of useful components will be collected and recycled for later use. Exploiting that circumstance, redundant weapons could serve as tools in productive landscape transformation. (Figure 1.3).

Artillery shells and their launchers, both of which come in a wide range of sizes, demonstrate the basic working principle of conventional weapons. The performance of each weapon configuration is rated according to its attack capabilities, such as penetration depth, blast radius, crater size, flying range, and trajectories. The performance of a weapon is influenced by a wide range of parameters, such as the shape of the shell, the type of launcher, and properties of the striking surface (Laur, Llanso and Boyne 1995). Different launchers can shoot different trajectories, which are suited to various terrains. For example, a howitzer has a moderate range and relatively flat trajectory, so it performs well in forested, rough, and hilly terrain, while a mortar has a shorter range and higher trajectory, so it performs better in rugged terrain. Those property features guide the selection of particular weapon types according to the explosive scale needed and environmental conditions encountered. Typically, the area between the launcher and the blast zone is safe from detonation (Korhonen 2006; Global Security n.d.) (Figure 1.4).

Munition Circulation

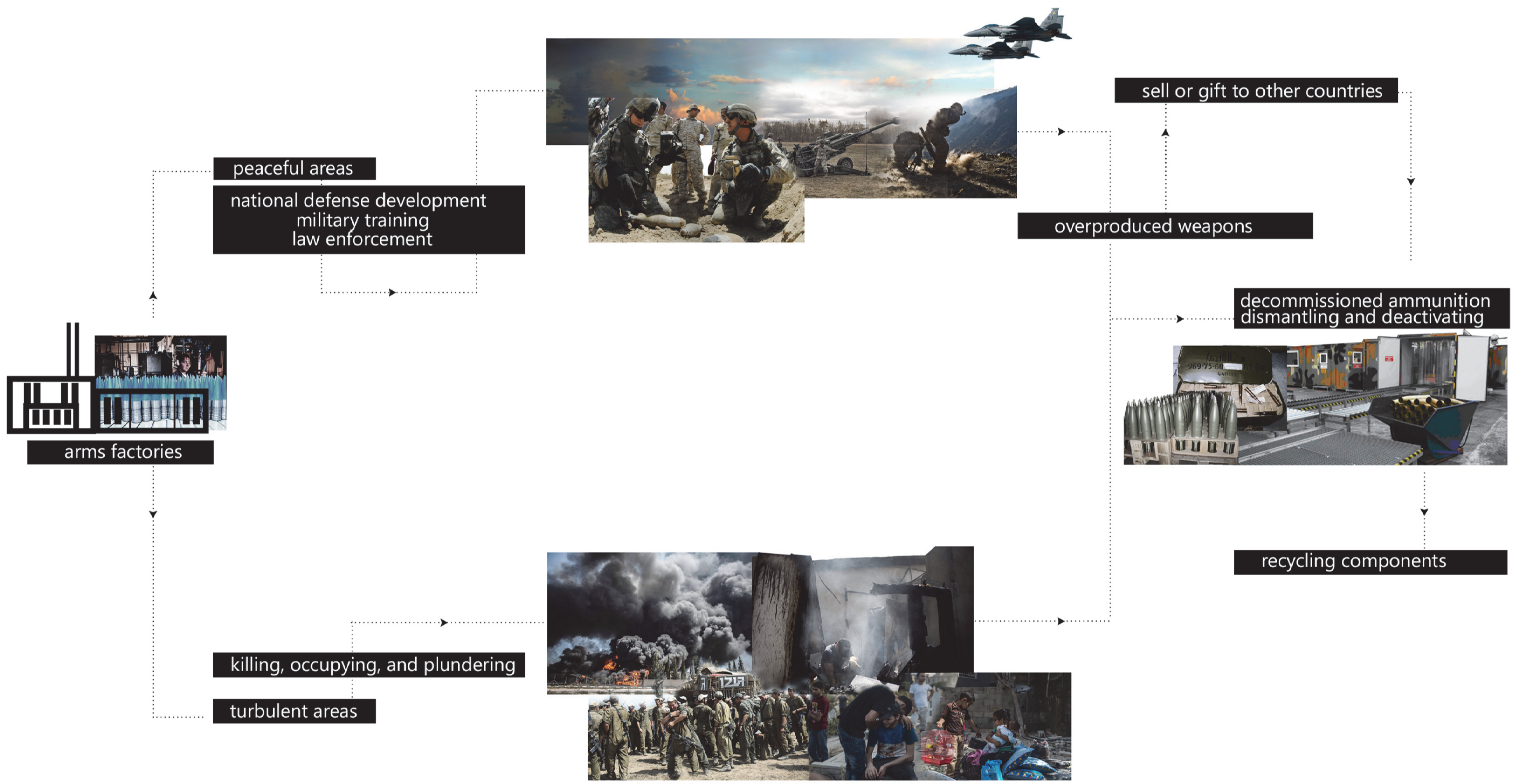


Figure 1.3 - Munition Circulation

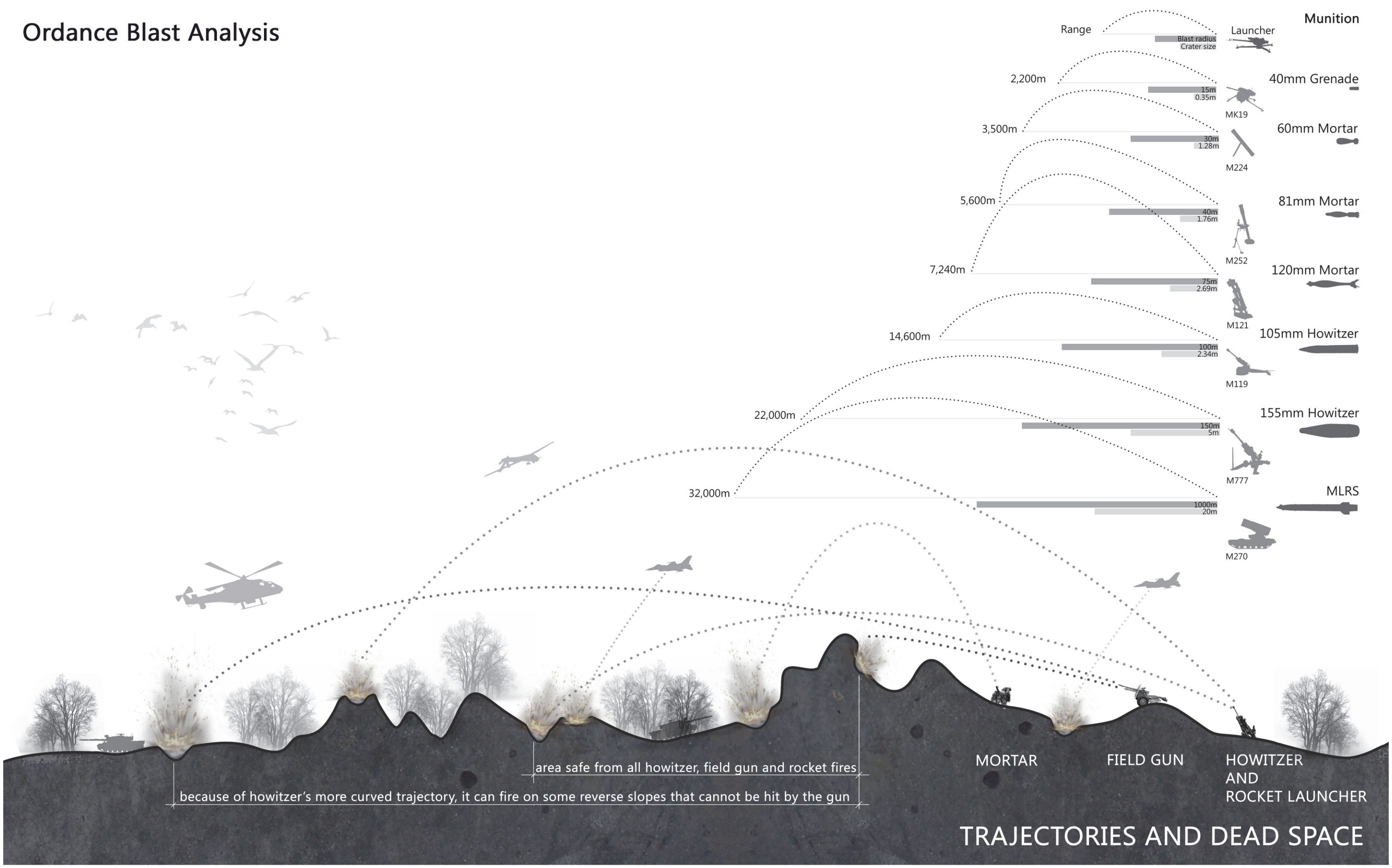


Figure 1.4 - Ordnance Blast Analysis

CHAPTER 2 CONCEPTUAL FRAMEWORK

Videos and still images of weapon blasts can be readily observed online, from bomb craters during the Vietnam War in Laos, to nuclear explosions at the Nevada Test Site in the United States and Bikini Atoll in the Marshall Islands, as well as firing and blasting processes in training (Lloyd 2013; Jackowski and Ostos 2008; Petkov 2013). Depending on the detonation mechanism, two aspects of projectile weapon deployment show their particular relevance and productive potentials for landscape. One is the long distance blast with low impacts on surrounding areas that has minimal soil compaction and destruction of vegetation. Put to productive use, such blasts could be used to expedite removing of derelict structures while minimizing soil compaction in the vicinity range. The process would be efficient and save human resources over a conventional demolition approach, because bomb launching is instant and a single launching installation could involve multiple targets. The other aspect is the bowl-shaped crater created by detonation, which could have value in ecological landscape management—for example, for the collection of rainwater (Figure 2.1).

Crater studies have been undertaken that frame detonation as an extreme landscape technique (Jackowski and Ostos 2008). The physical effects of detonation can create various impacts on different landscape surfaces, such as forest, grasslands, barren land, wetlands, asphalt roads, as well as structures, such as concrete buildings. In addition, the amount of power needed and the type of bomb appropriate depend on the distinct structure to be removed or the crater to be generated. Typically, the depth of a crater is roughly half of its radius and depends on target soil. The radius of a crater also depends on the distance between detonation location and surface level

(Kinney and Graham 1985). For instance, a 60mm mortar has a direct hitting power equivalent to 1-2 pounds of TNT and cannot penetrate most rooftops; an 81mm mortar is equivalent to 2 pounds of TNT and can penetrate light buildings; a 120mm mortar is equivalent to 10 pounds of TNT and can penetrate deep into a building together with extensive damage inside; and a 155mm howitzer is equivalent to 15 pounds of TNT and can blow up a building and cause extensive perimeter damage around the structure. Taking account of the highly guided and precisely controlled weapons technology currently available, through overstock supplies, the efficacy and efficiency of detonation could be effectively guaranteed (Koplow 2010). For example, stealth bombers with sensitive space-based sensors and precise satellite navigation can drop smart bombs exactly where expected and provide supremely accurate strikes (Hambling 2005) (Figure 2.2).

Redundant, retired weapons need to be deactivated for security. Two processes of munition deactivation are now conventional. One is to dismantle shells, remove the explosives, and then recycle the useful materials. The other is to cut a suitable pit, bury several shells arrayed regularly, then detonate them and clean up the contamination made by the blast. But weapons can be deactivated in a productive way, making use of their structure and energy. In the proposed process, some transformative actions need to be conducted first to eliminate or reduce the amount of environmentally harmful substances and thereby to ensure that the process is as environmentally friendly as possible. Then, the device can be amended to suit specific functions. For example, seed bags and nutrients bags can be added to the shell, so it will seed and fertilize a site when the shell is blasting. Take the Mark 81 bomb as an example. After dismantling, all of the original explosive can be removed in order to refill the shell with biodegradable materials and environmentally friendly explosives, such as Diazyltetrozolate and Hydrozinium azide (N5H5). Diazyltetrozolate is made of 90% nitrogen, and Hydrozinium azide is water-attracted and defused, so they will guarantee there would be no noxious explosive residues. Then, after refilling, the bomb can be reassembled (Carrington 2001). Deploying such amended shells will change not only the targeted topography or physical surface conditions, but also possible vegetation scenarios. In addition, the proposed processes will be controlled by correlative agencies which are capable of accurately controlling the detonation process to ensure security and avoid negative influences on surrounding context (Figure 2.3-2.4).

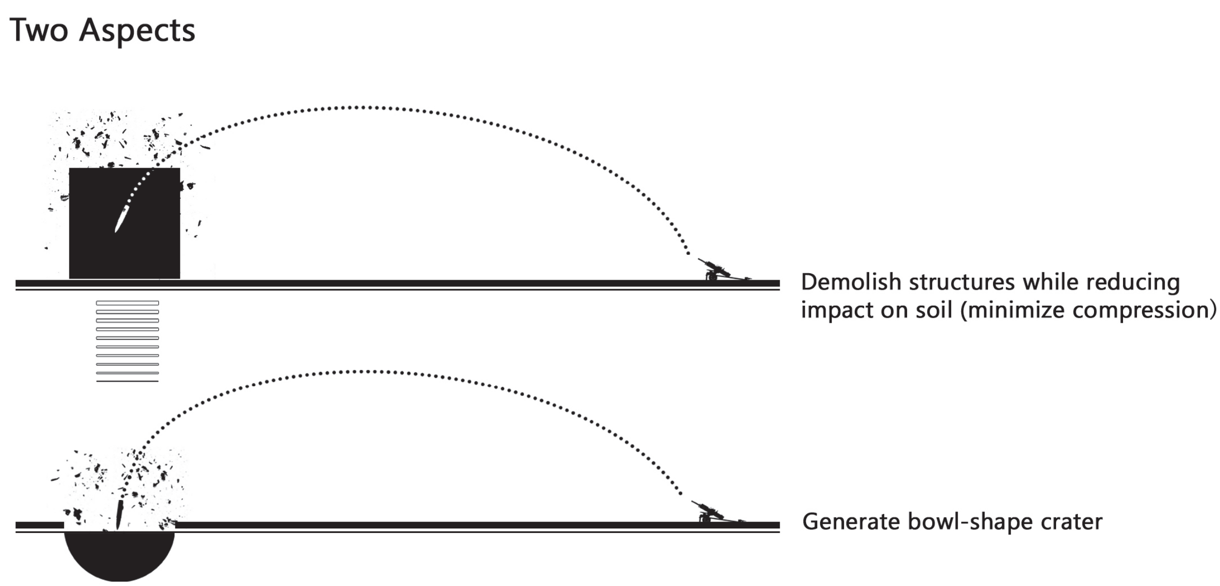


Figure 2.1 - Two Aspects of Bomb Detonation

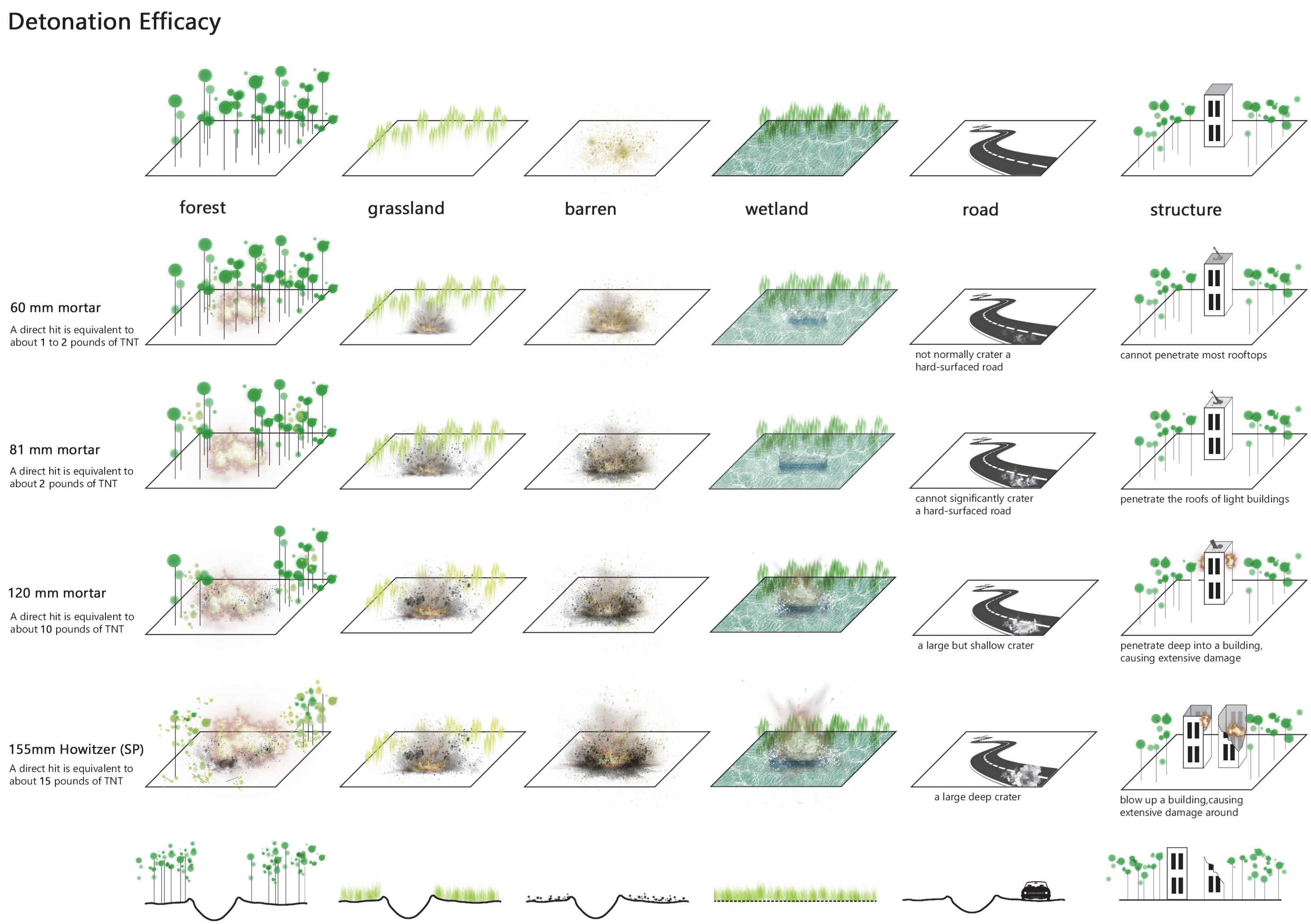


Figure 2.2 - Landscape Detonation Efficacy

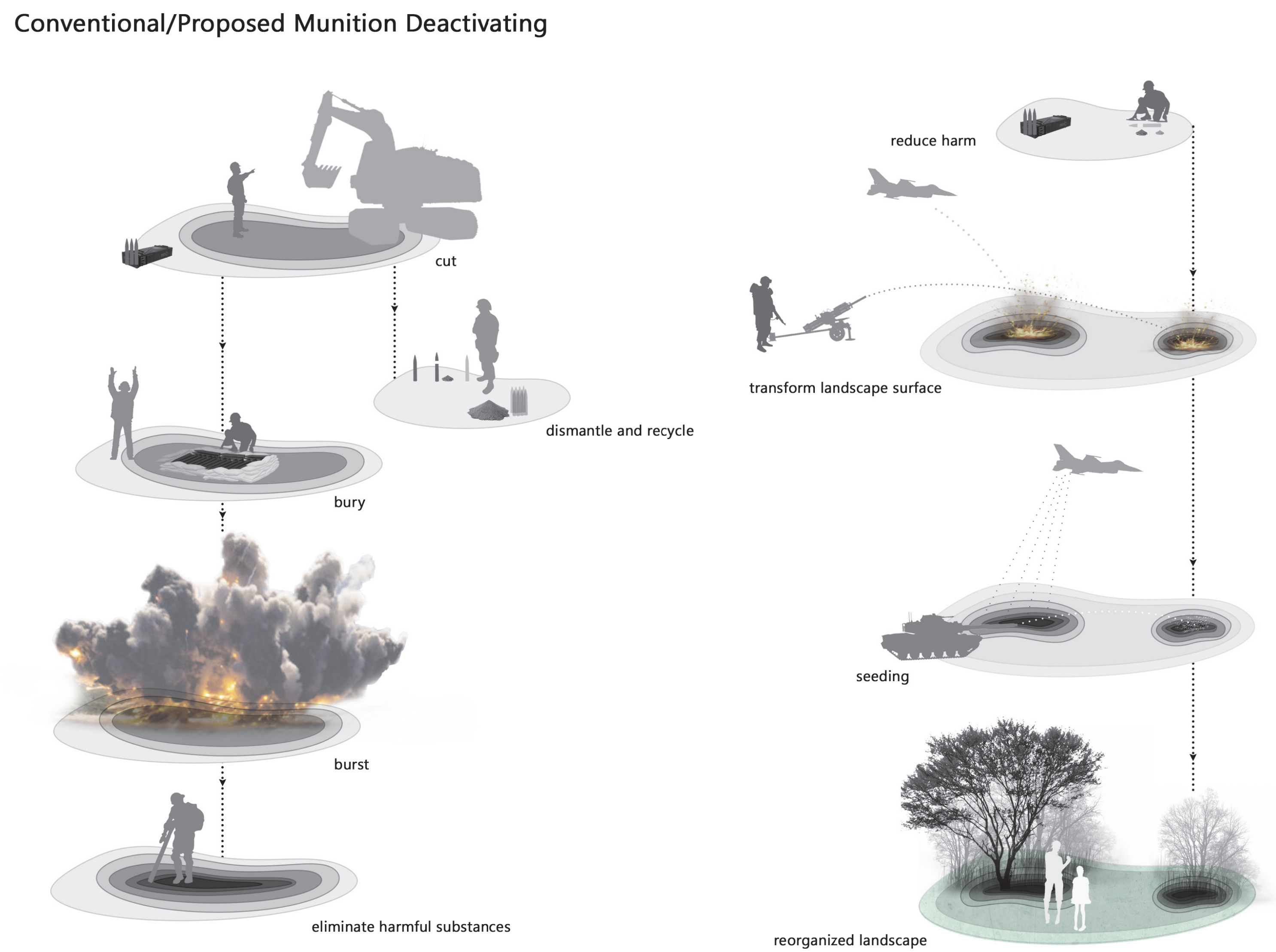


Figure 2.3 - Two Approaches of Munition Deactivating

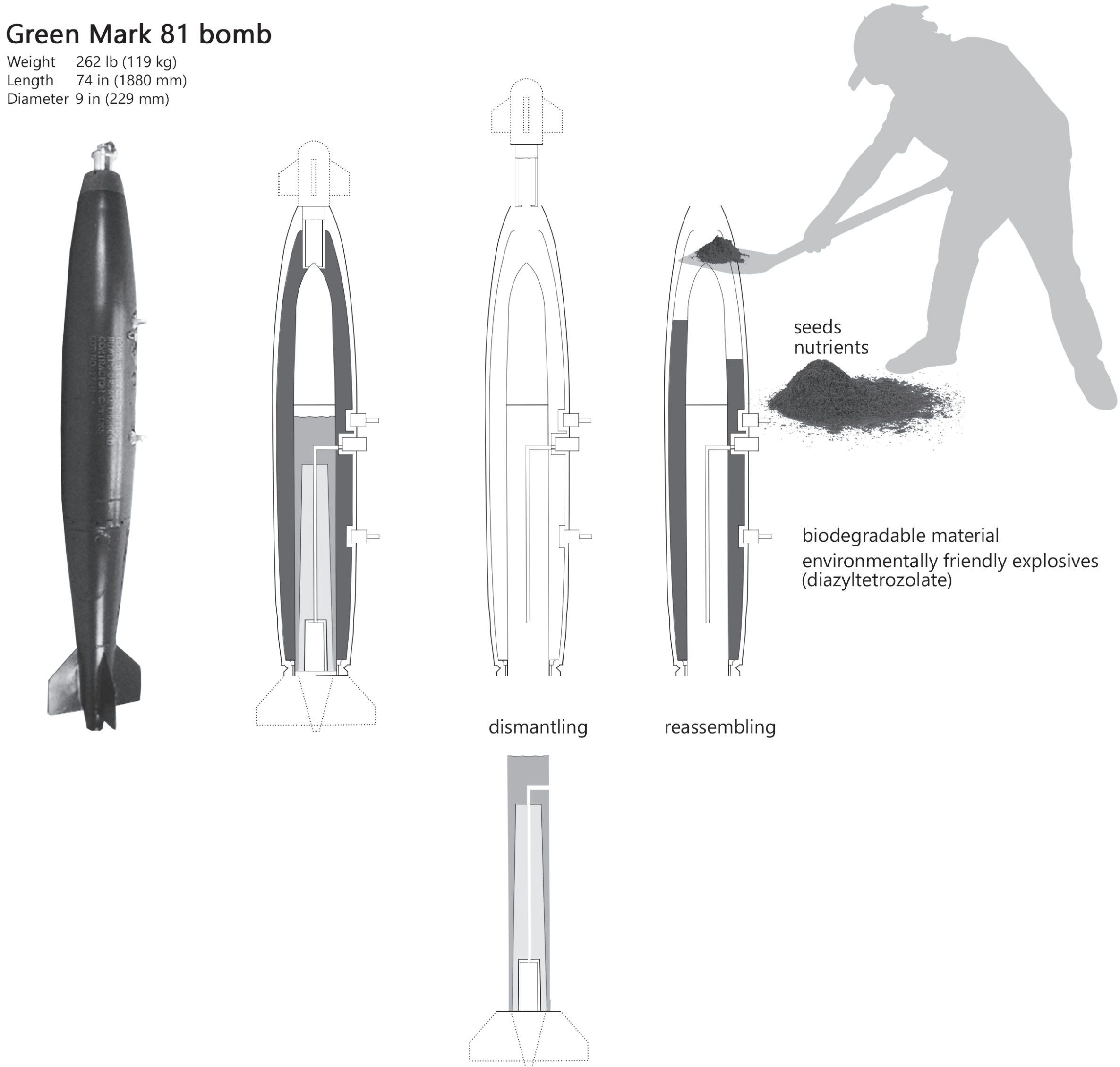


Figure 2.4 - Green Bomb

CHAPTER 3 DESIGN RESEARCH

<u>Site 1: Detroit, Michigan</u>

Site 1 is central Detroit, and the objective is to efficiently remove derelict structures with minimal soil compaction and other impacts on surroundings compared with a conventional demolition process.

In Detroit, failing industry produced intense social, racial, and political tensions. Not only is nearly half of the city's area vacant, but also many buildings remain with no hope of use (Fein 2013). There is simply not enough demand to sustain the amount and character of those buildings. The city has to clear these blighted structures: as many as 40,077 structures, mainly no doors or windows, have to be demolished in the next few years, and this clearing process will cost billions. Eliminating blight will conspicuously improve the existing urban landscape and may help recreate vigorous neighborhoods in Detroit (Blight Removal Task Force Steering Committee 2014) (Figure 3.1).

In Detroit, abandoned buildings can be demolished by bomb blast. The reduced impacts associated with that approach, such as low to no compaction of soils from machinery and preservation of surrounding vegetation, are beneficial for later land recovery and redevelopment of the whole transformative industrial city. Conventional demolition of large, abandoned buildings uses TNT and leaves toxic substances, while using heavy machinery has severe negative influence on site conditions, such as high compaction of soil and crushing and destroying of vegetation. Those disadvantages go against many land reuse purposes and increase the amount of soil loosening labor except when the new purpose is a pavement or new construction requiring highly compacted soil. As an economic and efficient alternative, and with consideration to the rational repurposing of redundant weapons, it is not only feasible but also preferable to use projectile bomb blasts to create more space for agriculture and other green open areas for redevelopment in Detroit.

Of the more than 40,000 blighted structures recommended for removal in Detroit, most are residential structures. Blight categories are redefined by the Task Force with integrated consideration of physical, economic, and welfare-based aspects (Figure 3.2). Seen from the total scope of blight, if these structures were removed by conventional methods using heavy machines, the areas around the buildings would be highly impacted (Figure 3.3, top). A lot of area is affected, so a large amount of soil is heavily compacted. However, if all those structures were removed by the proposed method using projectile bomb blasts, the compaction of soil and crush of vegetation would be minimized. Given the scale of demolition anticipated, such an approach would make a real difference for the whole city (Blight Removal Task Force Steering Committee 2014) (Figure 3.3, bottom).

There are several, considerable differences between lowly impacted soil and highly impacted soil. The highly impacted soil has smaller pores, lower infiltration rates, smaller roots because of more difficult root penetration, less earthworm activity, reduced soil drainage, less nutrition, and reduced air content. All of those are disadvantages for future development and will increase costs by requiring soil transform action (Figure 3.4).

In assessing the impacts of building demolition on soils, the force causing soil compaction is measured in pounds per square inch, and both the psi and frequency or duration of the pressure are important. In a conventional demolition process, dangerous dead brush, trees, trash and illegally dumped materials are removed by heavy machines that compact soil around 40 psi. Those that then knock down the vacant structures and other urban decay are about 35 psi. Lastly, removal of the debris involves machines around 40 psi. The area impacted most by heavy machines occurs around the removed structure. Just as in a conventional process, the proposed process would begin with thorough checks to ensure that there are no people in the target areas during the detonation period. First, surveying the existing condition and calculating how much energy will be needed for demolishing each structure would require about 8 psi soil compaction for a technician. Then, conducting the blast would involve about 8 psi for an operator at one place at most. Thus, vegetation around the building would be kept, and there is no need to remove the debris around the building before the blast. Last, using light machines to remove debris and to recycle useful materials would require about 12 psi for a common light machine. The amended process would overall introduce less soil compaction than the heavy machinery method. Given low soil impact, the resulting cleared site would be available to a wider range of possibilities as newly available open space (Figure 3.5).

Take the Petosky-Otsego neighborhood of Detroit as an example. This community is one of the most abandoned neighborhoods in Detroit. Demolition has taken place continually in Detroit throughout the past years, and the whole of the Petosky-Otsego neighborhood has been affected. Although the amount of buildings demolished is not the largest, they are extensively distributed. 37.8% of this community is unoccupied, and there are 2,614 unoccupied buildings. With large brick homes and two-family flats, this area was booming in the 1920s with a primarily Jewish population. Thus a great amount of buildings were constructed nearly 100 years ago. However, it eventually gave way to rampant crime, poverty, and abandonment. Some blocks are lined with garbage, burned-out brick homes, and overgrown lots. This neighborhood has a typical residential layout: organized grid living blocks with commercial along the main street. According to the proposed land use zones in Detroit Future City's 50-year plan, more than 90% land of this community will be transformed into an innovative ecological area, remaining a spot of green mixed use as well as traditional medium residence, which means there would be a completely massive land transition in this area to achieve this aim (Loveland 2014).

The central west area of the community, bounded by Collingwood Street, Yosemite Street, Petoskey Avenue, and Kay Street, is chosen for testing. A two-person team with 120mm mortars shot by M121 artillery will undertake the demolition operation. In addition, this type of mortar requires a minimum 200m launch range. For the sake of security and accurate control, the shooting range will be restricted to no more than 3 blocks even though the artillery has a 7240m maximum range. A small number of buildings in very close proximity to the targets cannot survive explosive blasts of the suggested power and will be demolished as well. Removing the blighted structures by the proposed method would leave lowly impacted areas around the structures. After the blast, the existing vegetation in the central area of every block, which already functions as green corridors, can be connected together with the low impact areas created by blast, forming a larger recreational and ecological green network. This approach can be expanded into the whole city; thus, there would be plenty of diverse spaces serving as basic units of a city-scale green network (Figure 3.6-3.12).

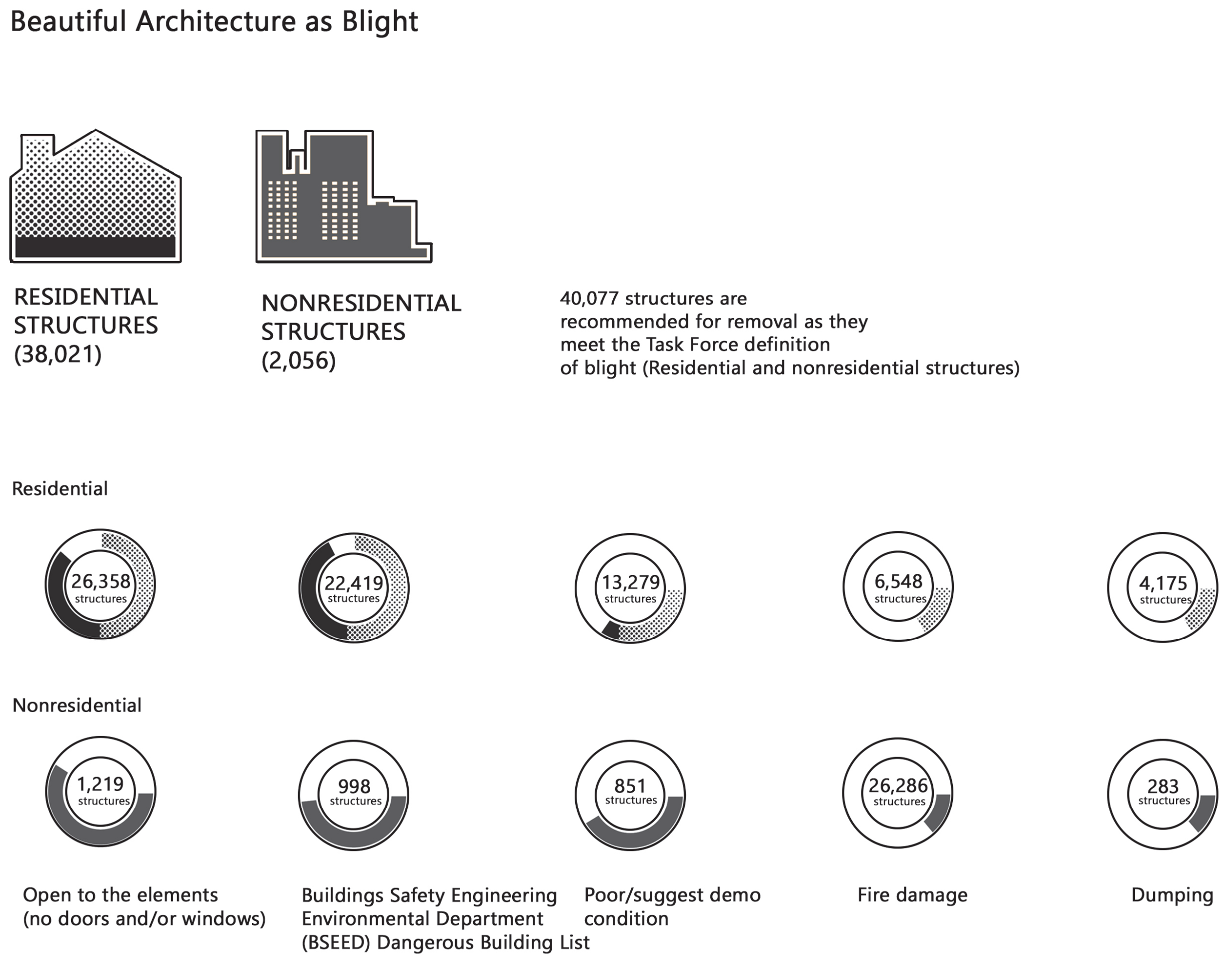


Figure 3.1 – Beautiful Architecture as Blight

Blight Removal Task Force Steering Committee 2014

Defining Blight

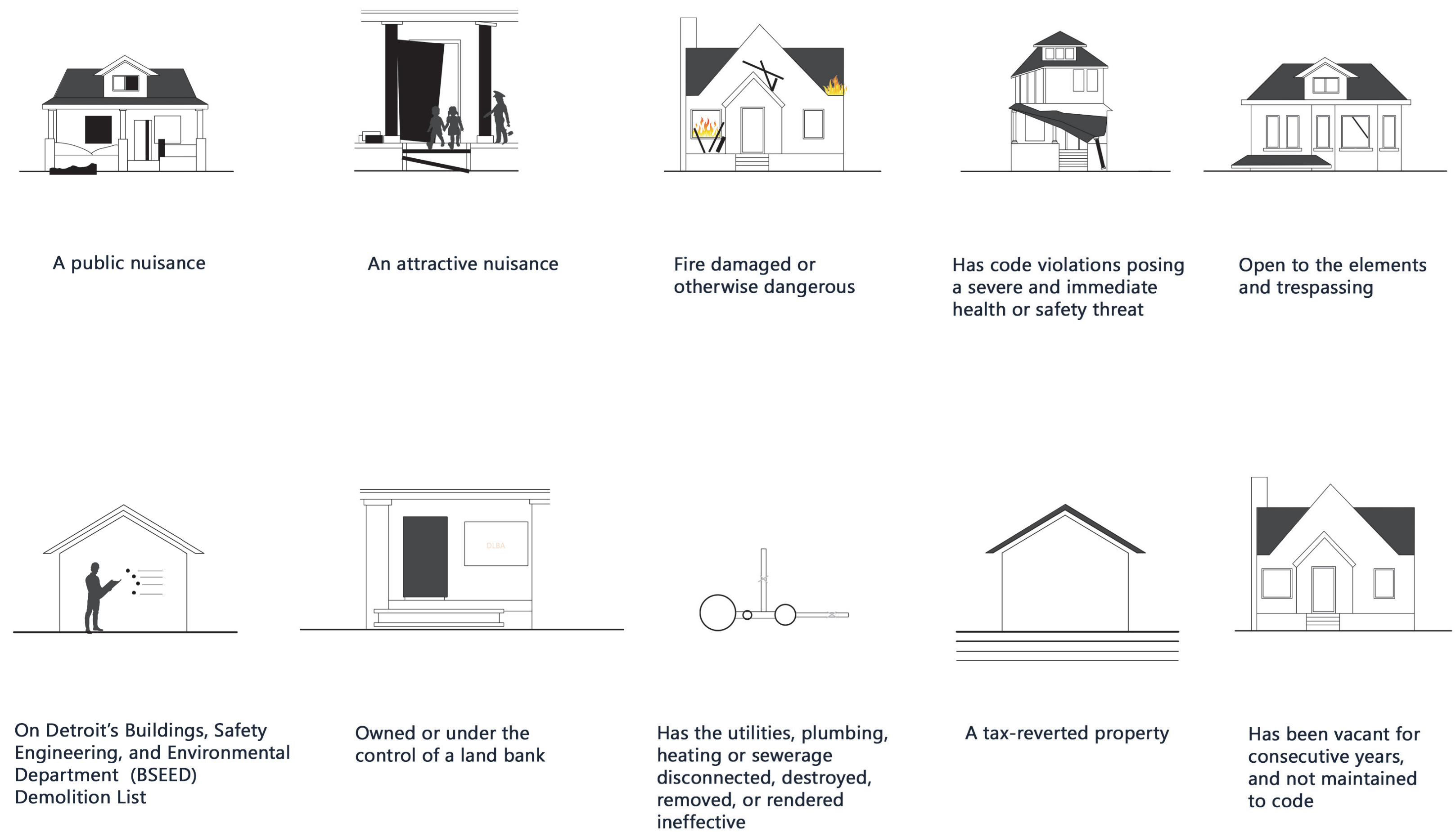
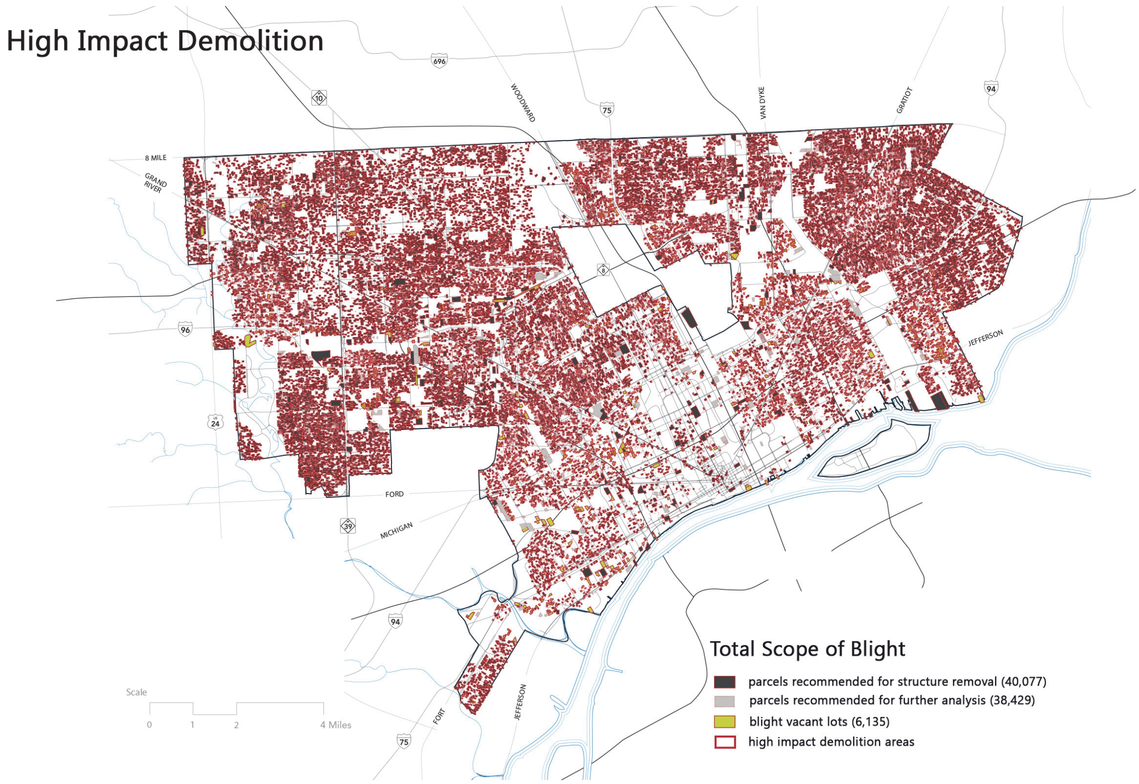


Figure 3.2 - Blight Categories

Blight Removal Task Force Steering Committee 2014



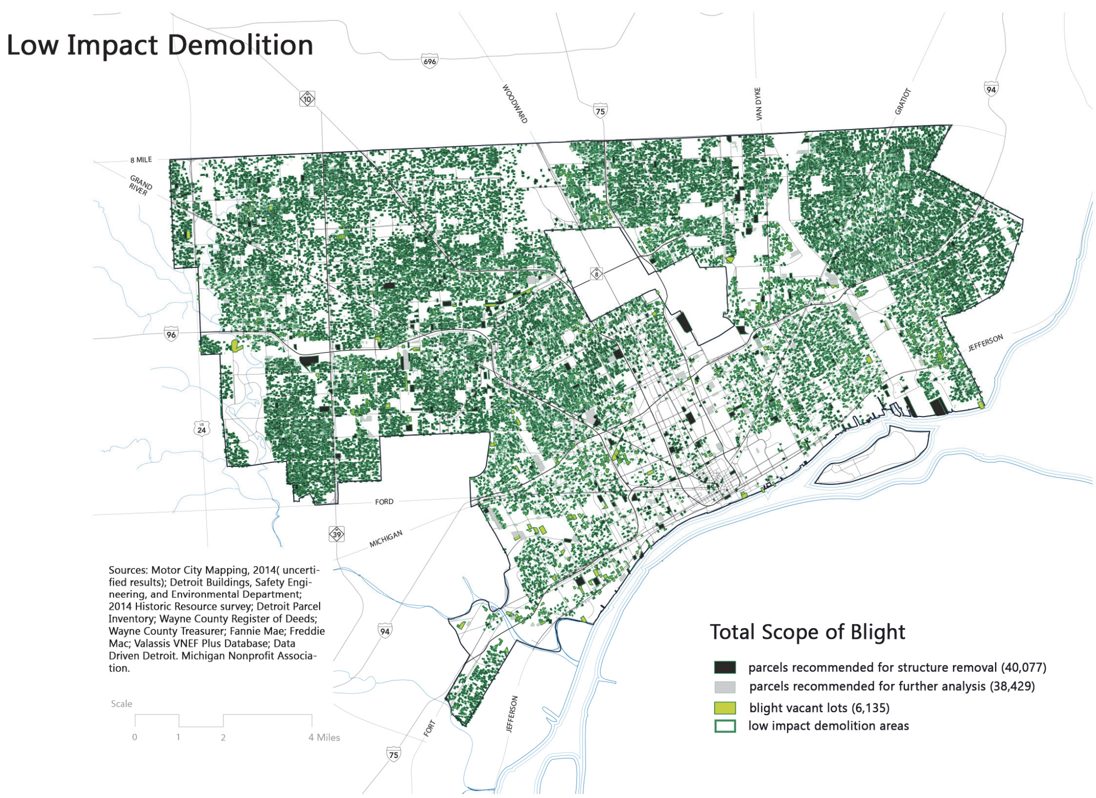


Figure 3.3 - Total Blight Scope in Detroit

Blight Removal Task Force Steering Committee 2014, modified by the author

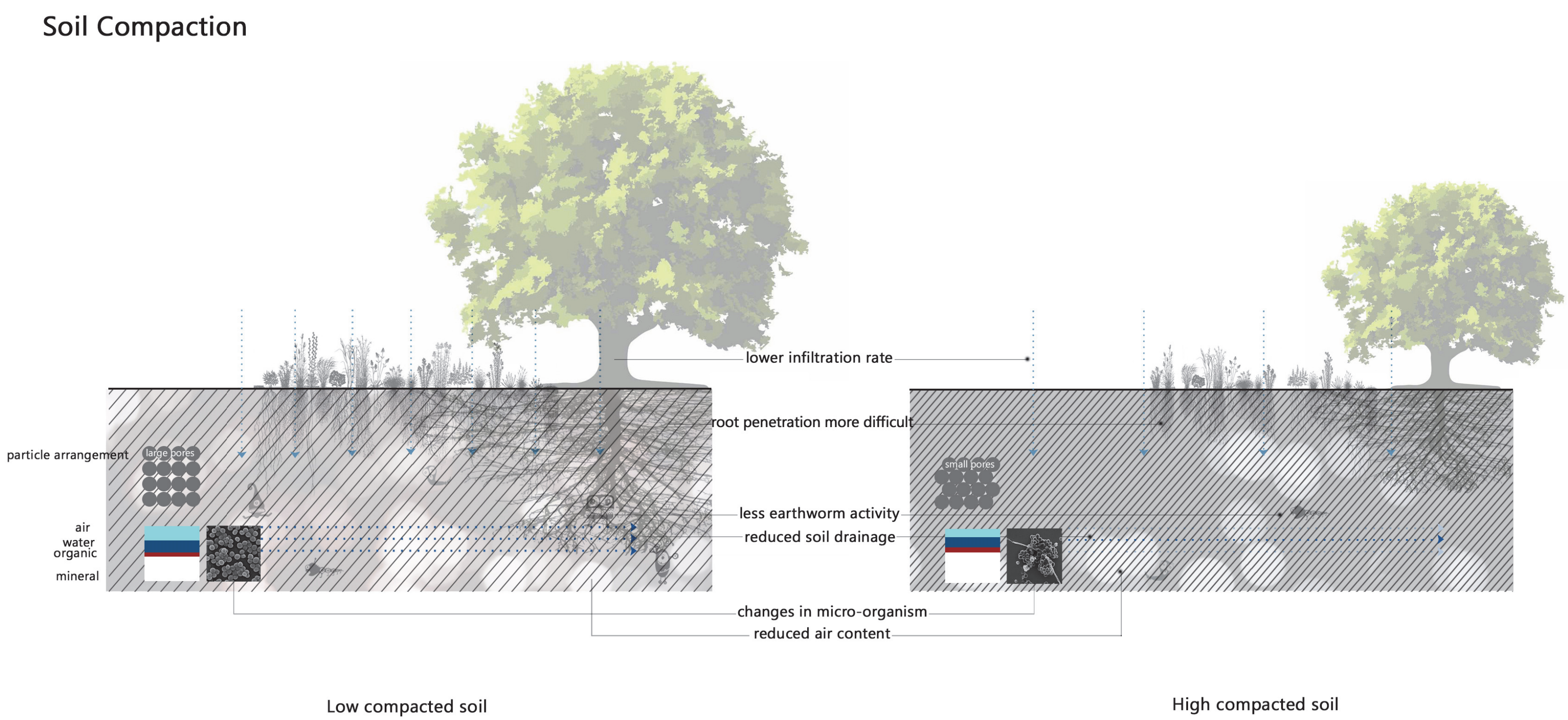


Figure 3.4 - Soil Compaction Conditions

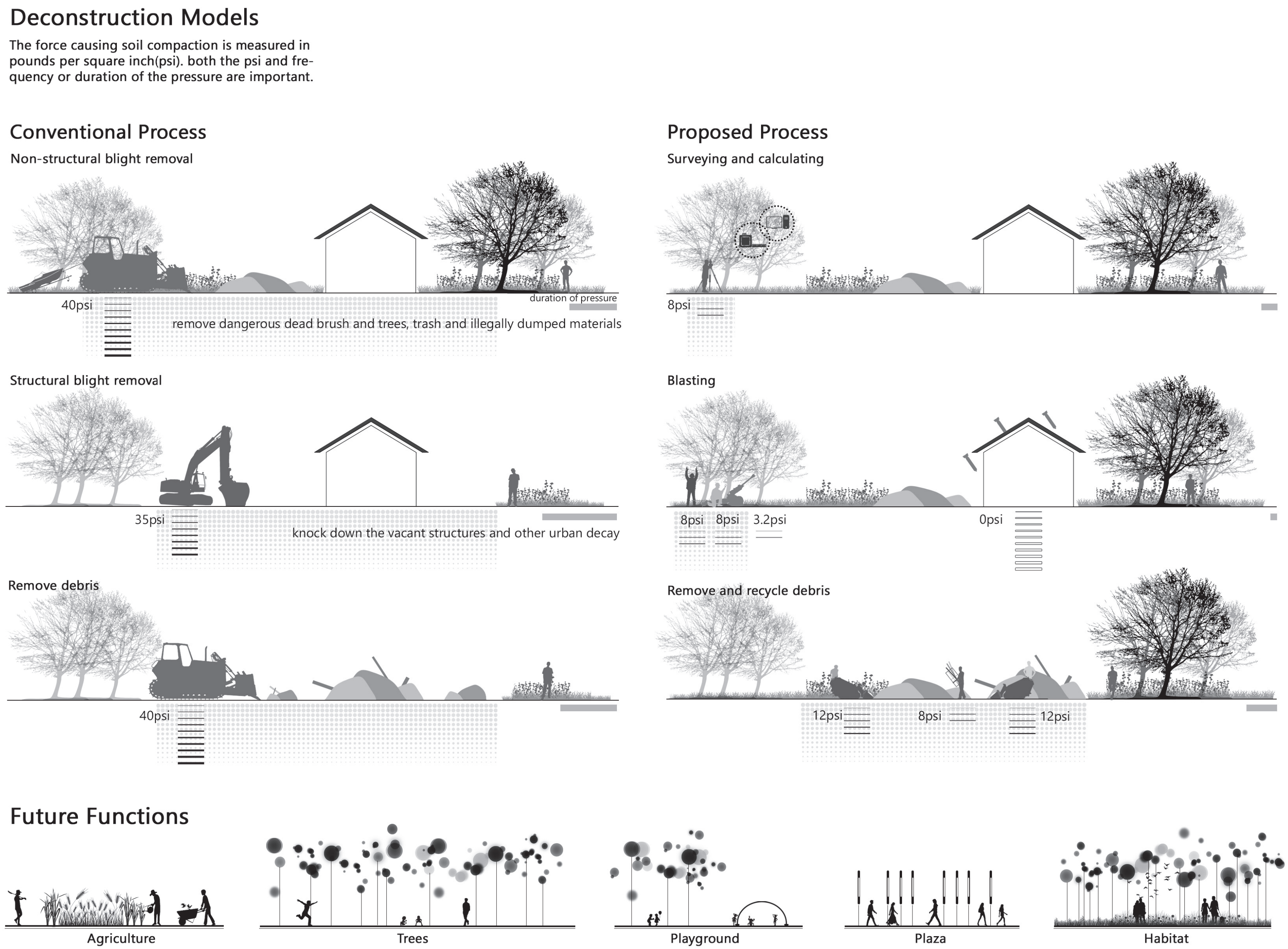


Figure 3.5 - Two Deconstruction Models and Future Functions

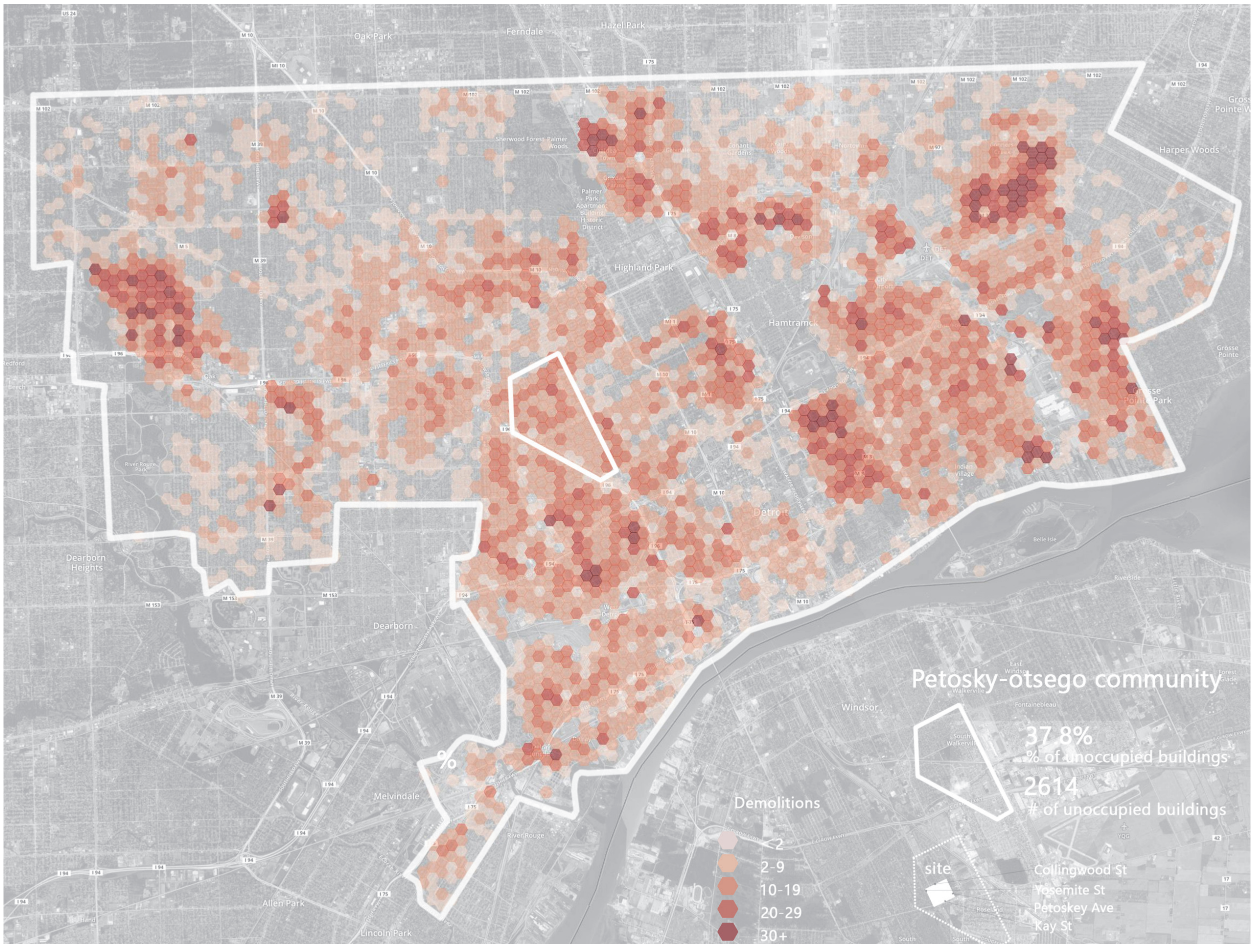


Figure 3.6 - Location of Petosky-Otsego Community

Loveland 2014

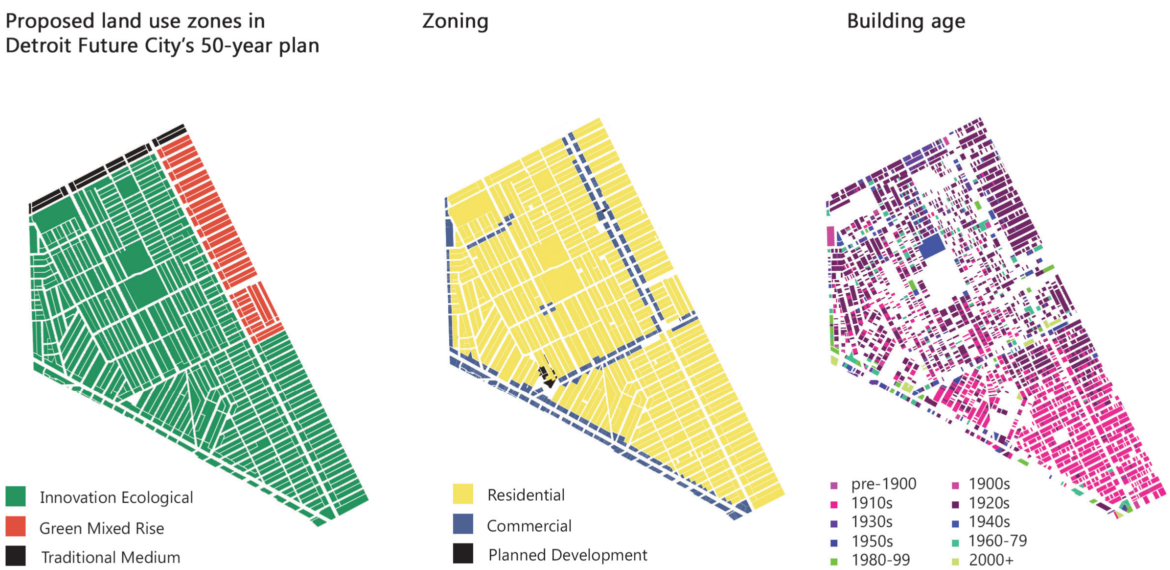


Figure 3.7 - Petosky-Otsego Community Existing Condition

Loveland 2014

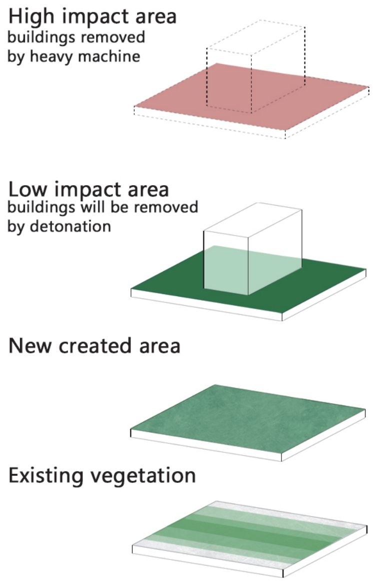


Figure 3.8 - Ground Typology

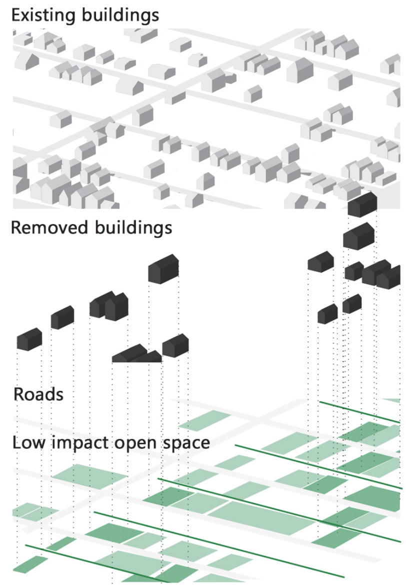


Figure 3.9 - Demolition Layers

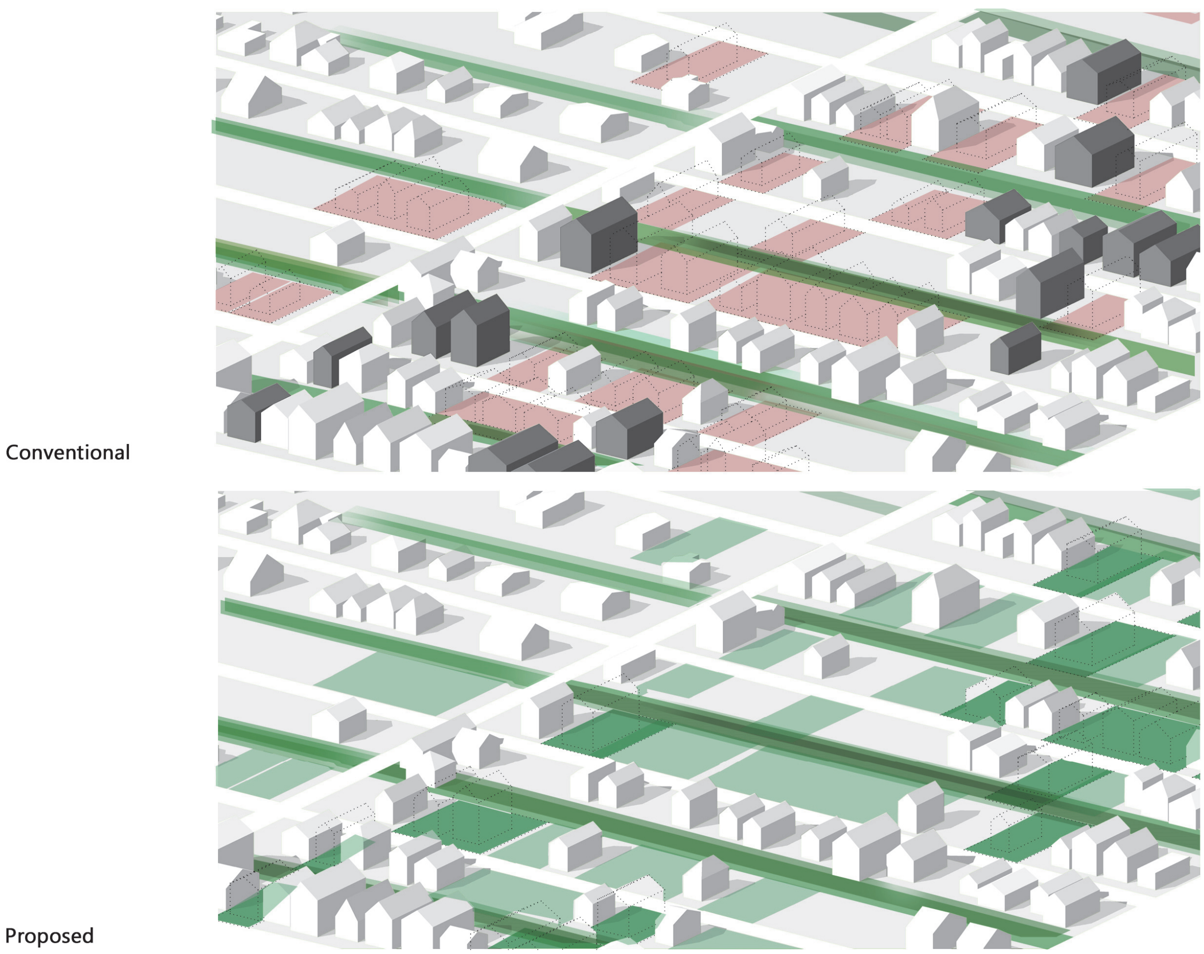


Figure 3.10 - Before and After Demolition

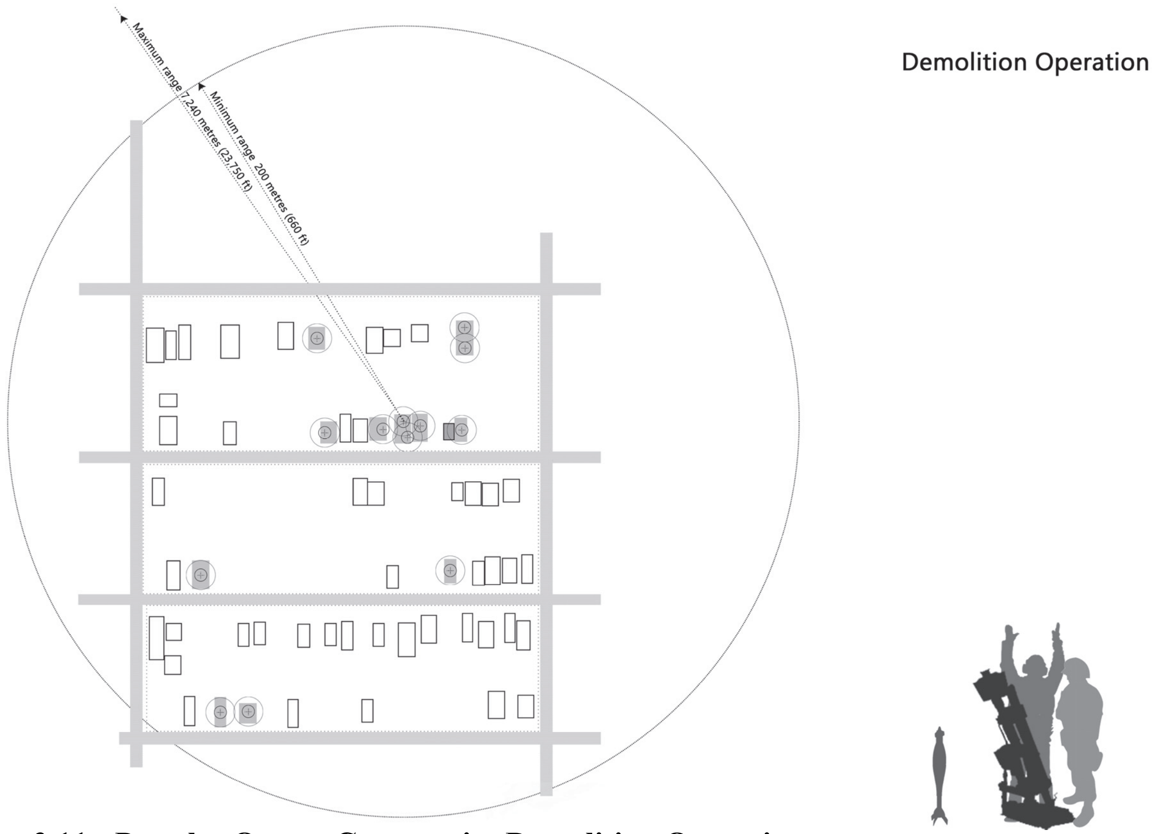


Figure 3.11 - Petosky-Otsego Community Demolition Operation

Figure 3.12 – Demolition Process and Future Scenario

Site 2: Lake Chad, West Central Africa

Lake Chad is an endorheic lake spanning the borders of Chad, Niger, Nigeria, and Cameroon and bordering the Sahara desert in West Central Africa. The lake is freshwater and, despite high levels of evaporation, serves as the third largest source of fresh water in Africa. It has been a significant freshwater source for agricultural irrigation in surrounding countries (Nairobi 2008). In addition, Lake Chad is a distinct Sahel ecosystem nurtured by the Chari-Logone and Komadougou-Yobe river systems. Approximately 95% of recharged water in Lake Chad is contributed by the Chari-Logone system. The lake area is also a dwelling place for more than 20 million people and constitutes biodiversity including hundreds of bird and fish species as well as abundant plant and other animal species (Bila 2005).

The lake volume varies remarkably due to the vast expanse of its water surface, shallow lakebed, and hot climate of Africa. The lake is a huge swampland in dry season and has an average 1.5 meter depth when the monsoon season returns (Pope 2008). Its maximum documented depth is 12 meters (Jauro 1998). Drawing from a sequence of stunning satellite images and videos, lake maps show a conspicuous shrinkage in the size of the water body within the past 50 years (Thomson 2001; Pope 2008). As a result of climatic unsteadiness, such as an unprecedented drought in 1970s, and increasing demands on water of agriculture, about 90% of the surface water area of what was once the world's sixth largest lake has dried up fast, from approximately 25,000 km^2 to 1,350 km^2 between 1963 and 2007 (Nairobi 2008). The lake has been replenished slightly due to increasing precipitation in this new century, but its overall drying trend still continues and its ecological situation gradually becomes vestigial. The United Nations Environment Programme (UNEP) indicated that half of the decrease of the lake has been caused by excessive water use for agriculture and the other half by climatic variation (Notaras and Aginam 2009).

The drying up of Lake Chad has caused a negative chain reaction on the region. Original shore communities are now far away from water. The production mode of whole communities has switched from fishing to uncoordinated cultivation and agriculture. Unconscionable irrigation and overstocking has led to invasive alien species; half of the lake surface is now covered by invasive plants (Notaras and Aginam 2009). The Lake Chad basin ecosystem has also been suffering environmental stress due to annual rainfall decline, continuous drought, increasing population pressure, unmanageable agricultural practices, and resource shortages (Bila 2005). As a consequence, water scarcity, crop failures, livestock deaths, fishing collapse, soil salinization, and desertification due to the changes of the lake raise continuous secondary problems, such as water pollution, water and food insecurity, decreasing biodiversity, animal migration, farmer conflicts, national conflicts, urban/rural migration, and river basin migration. All of these correlative influences are sophisticated as well as far-reaching (Pope 2008) (Figure 3.13).

Water is essential to livelihood in the area of Lake Chad, and the absence of water can be a catalyst for social instability. As political scientist Thomas Homer-Dixon wrote, “Future war and civil violence will often arise from scarcities of resources such as water, cropland, forest, and fish” (Homer-Dixon 1991). With that in mind, lake recovery management ought to be explored for the purpose of manipulating and improving the now worsening ecological and social situation, acknowledging and supporting the importance of Lake Chad for regional ecology and social stability. The countries within the Lake Chad basin and international institutions such as the United Nations have already put efforts into several transnational water management initiatives, including transferring a mass of water from the Congo River to revitalize the lake. However, those programs are highly expensive and require long-term, complex processes, so their dates of commencement and sources of funding are not yet guaranteed. (Notaras and Aginam 2009). A more efficient and economically reasonable approach to remediating the dying lake, converting it back into a vital oasis, is desperately needed.

The approach proposed here targets land between the existing shore of Lake Chad and its previous limit. Bombing craters can be formed to prevent desertification and "save" the lake. These diversely sized craters will act as gradually developed interventions, such as water pockets, water storage pools, fish pools, and pools for other purposes located on the shifting edges of the lake to reestablish a fluid ecological system. Five types of pools would be applied and distributed following five principles of function: amplification, extension, enrichment, connection, and revival (Figure 3.15). Those types are distributed in accordance with site geography and ecological circumstances. The eastern part of the lake has a rich natural landscape as well as extremely abundant fishing resources, so it has long served as a naturally defined area of fishing and tourism. In contrast, the southern part is desirable as agricultural land, and the western and northern areas are all barren or marshland. As a consequence of this, amplification pools are mainly located in northern and western areas to improve the range of the lake as an initial phase of management; extension pools are mainly located in the western and southern areas to increase amount of water and rehabilitate agricultural land and marshland; enrichment pools are mainly located in western and southern areas to achieve further improvement of extended pools; the connection pools are mainly located in western and southern areas around the river to dredge the replenishing channel and increase water supply from the source; and the revival pools are intermingled with the other four types as a compatible transitional and further refining phase. There would be different combinations of these pools in each area. In addition, there are several constituencies involved in the process, such as farmers and fisherman, and overall each will benefit from this reestablishment.

The process for forming crater pools of all types is sequential. First, suitably-sized craters are formed by detonation of weapons. The crater has less water infiltration on account of highly compacted soil within it. New craters can collect water from rainfall, ground water, and river recharge. Areas of and around craters can be seeded aerially or by people on the ground. The water holding capability of each crater, together with a gradual reduction of evaporation, increases with the growth of vegetation in and around it. Then, as plants keep growing in each crater pool and surroundings, well-developed pools with more stable water levels, as well as aquatic organisms, are formed. In the end, large numbers of diverse multifunctional pools will improve the regional ecological condition gradually and contribute to the stabilization and flourishing of local society.

The five types of pools have different dimensions and detailed conditions, including the wetland water pocket, storage pool, fish pool, habitat pool, and irrigation pool. Storage pools would develop as water tanks, and fresh drinking water would be available after purification proper; fishing pools would create fishponds and reestablish the degraded fishing industry; habitat pools would aim to attract more animals and native plants by rebuilding suitable local ecological systems and regaining biodiversity and ecological resources, which will benefit the tourist industry as well.

One type can transform to other types as a dynamic developing process. All of the pools participate in creating food chains for local areas, and all of the species in the lake area can benefit from this environmental improvement (Figure 3.14-3.19).

The testing site is located along the southern lakeshore. This area is near the southern river basin and has fertile soil streaming from its original agricultural use over long time. F-4 Phantom and Mark 81 bombs will be deployed in the demolition operation due to the large operating area. The density of pools is higher along the shore and tapers off farther inland. There will be expanded purpose in this area, so storage and irrigation pools are mainly formed to provide accessible water and a stable agricultural irrigation system for reviving agriculture (Figure 3.20-3.22).

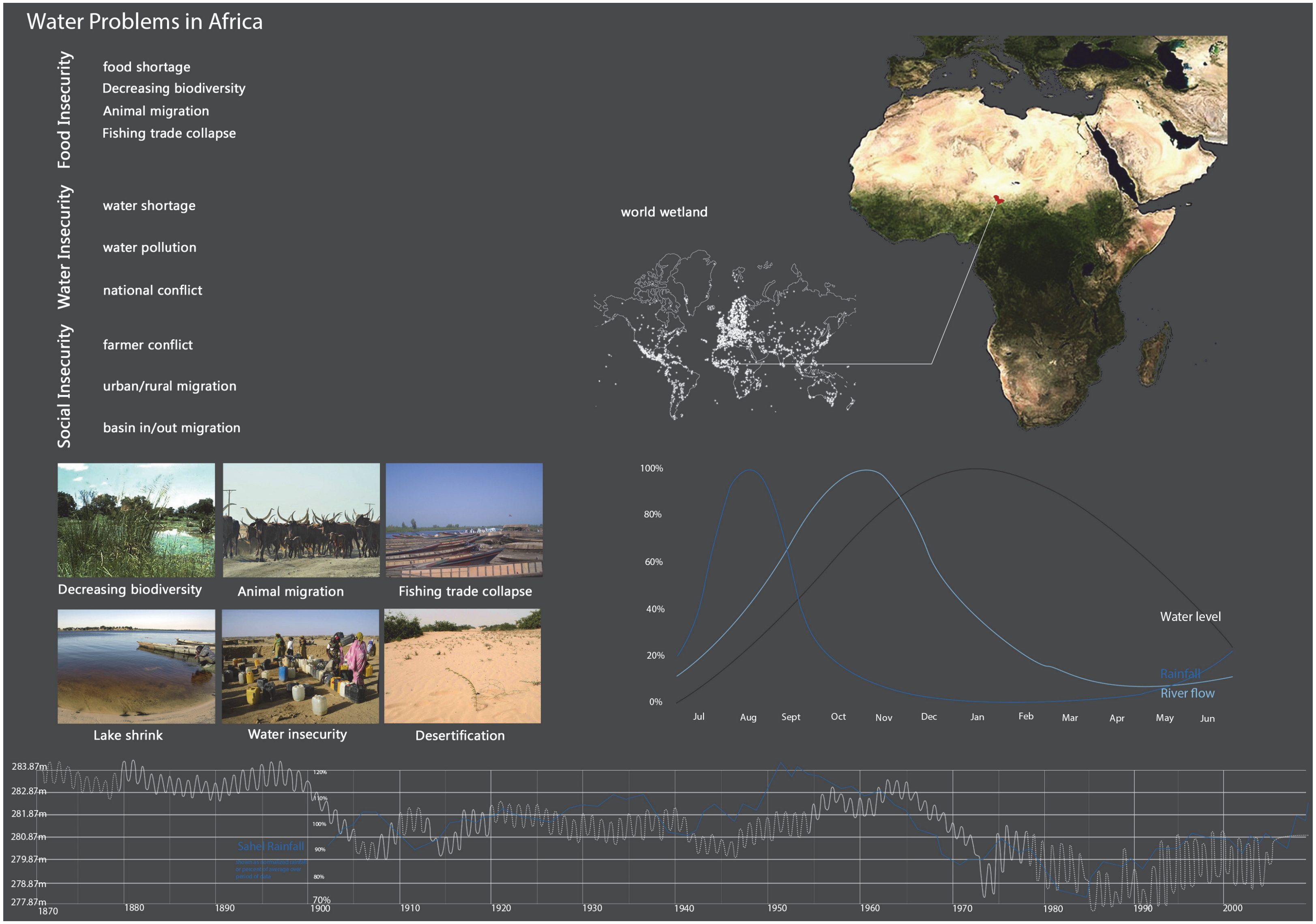


Figure 3.13 - Water Problems in Africa

Middle, Top: World Wildlife Fund, Kate Leeming 2010, Mustapha Muhammad

Bottom: Christophe Ena, A.Rehrl, Lake Chad Basin Commission

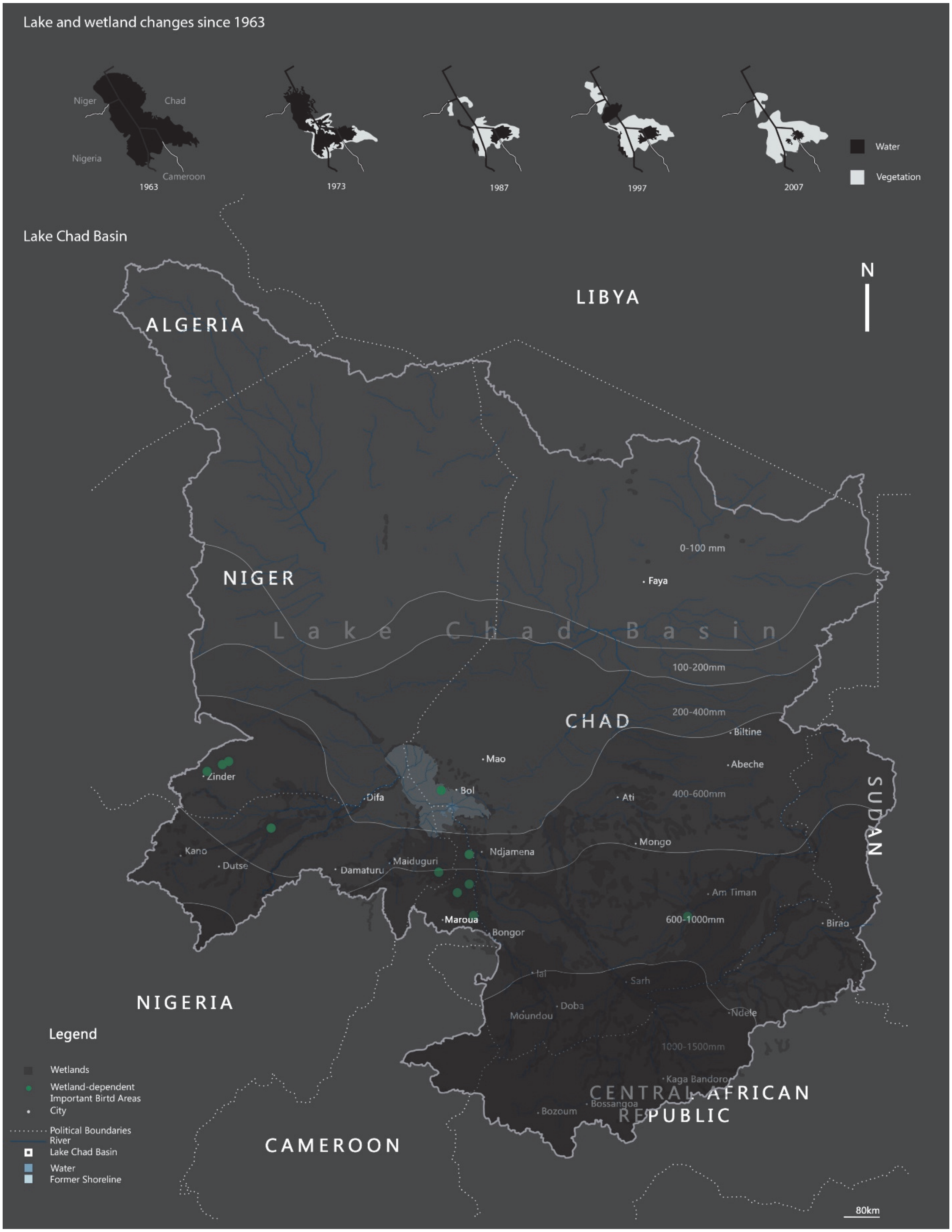


Figure 3.14 - The Lake Chad Existing Condition

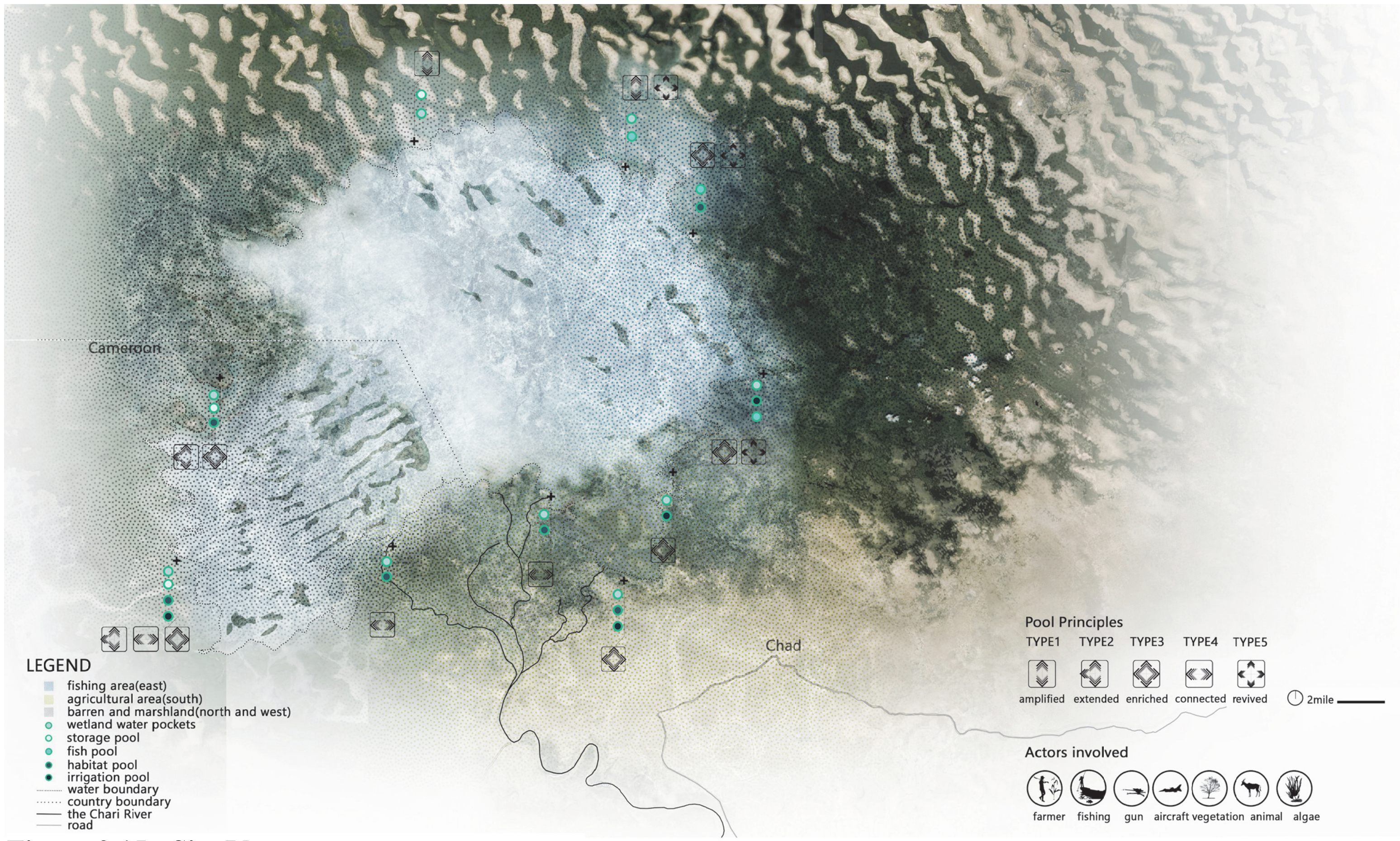


Figure 3.15 - Site Plan

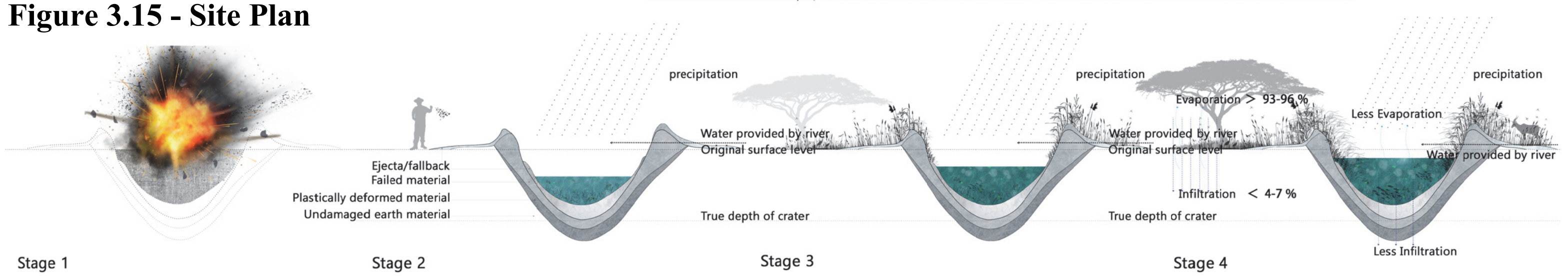


Figure 3.16 - Pool Generating Stages

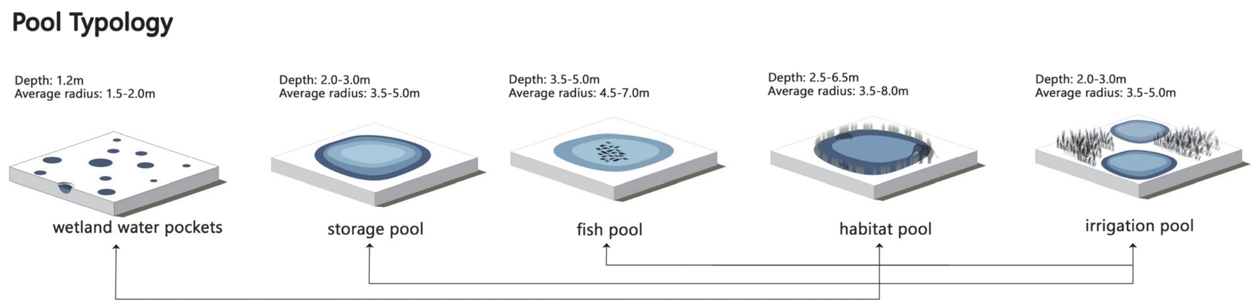


Figure 3.17 - Pool Typology

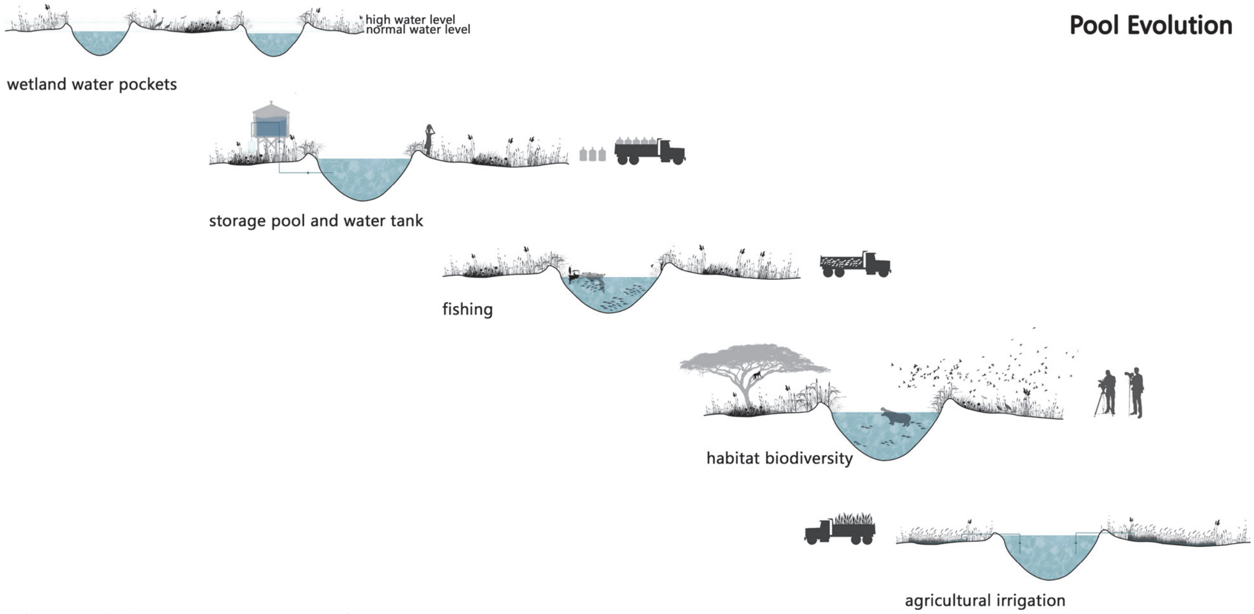


Figure 3.18 - Pool Evolution

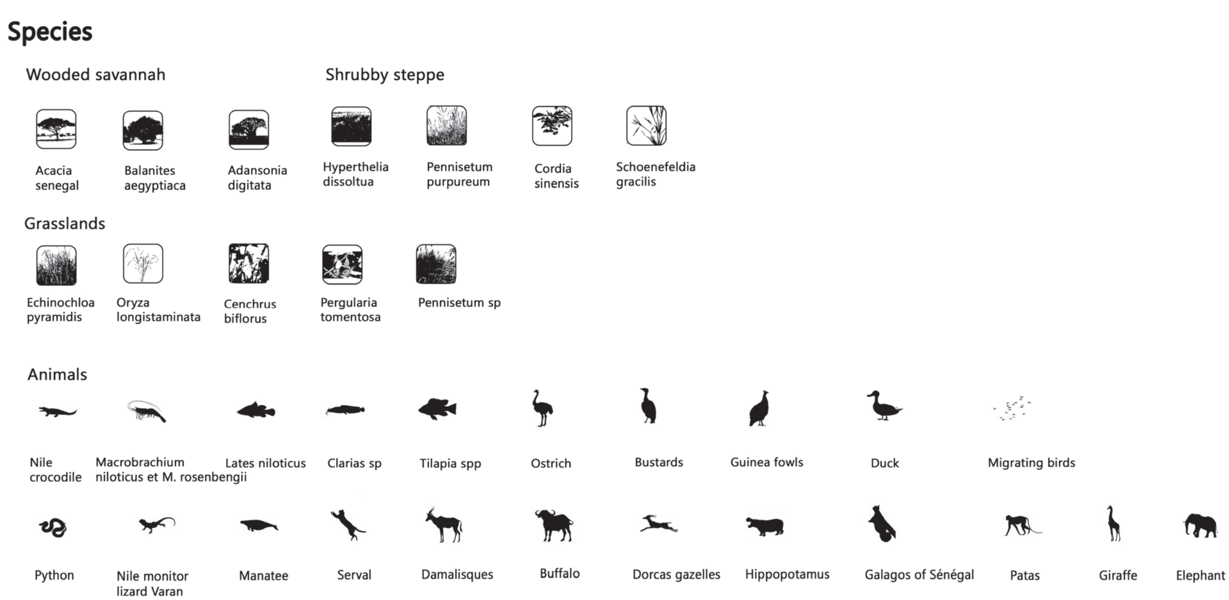


Figure 3.19 - Species within the Lake Chad Basin

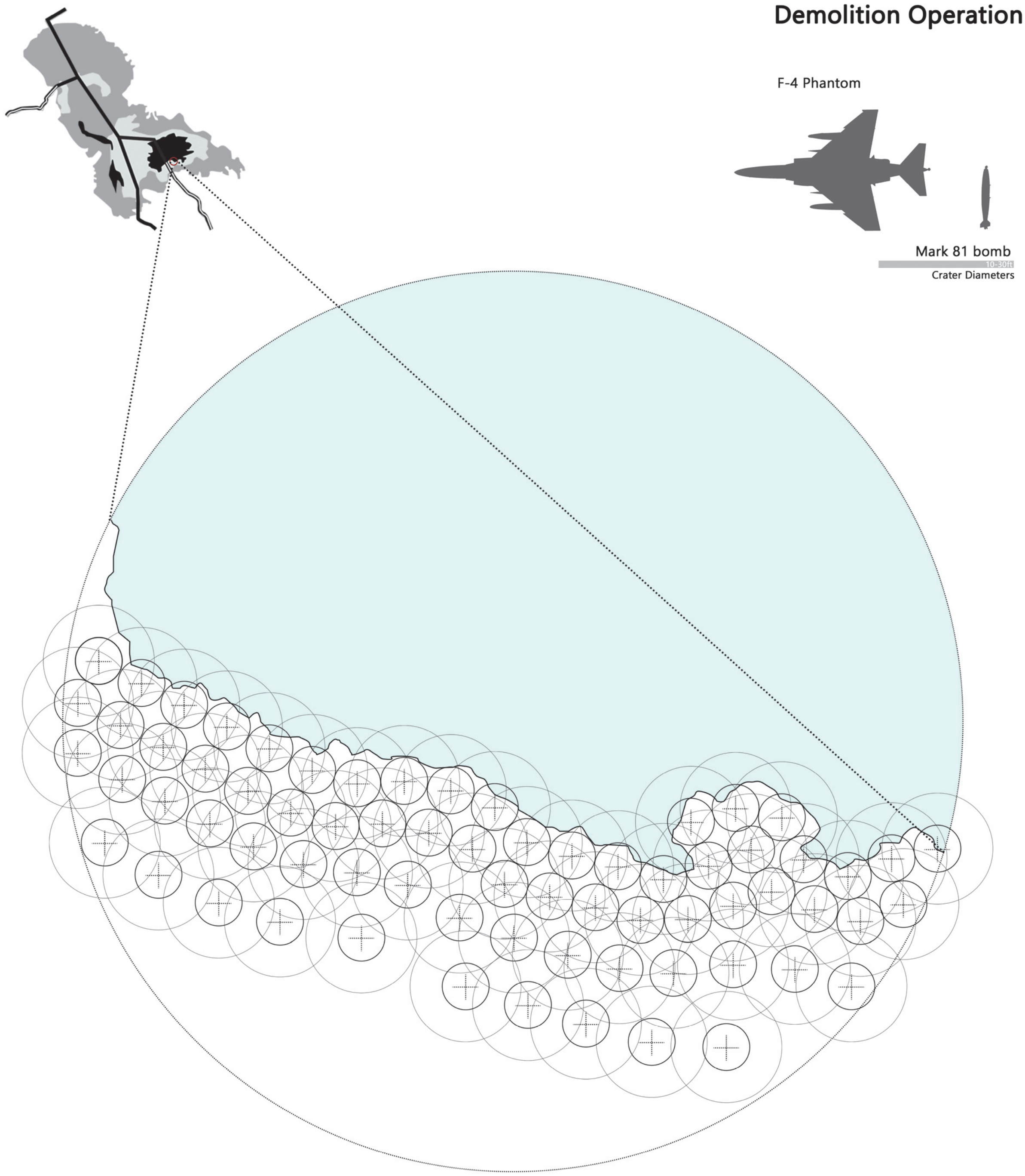


Figure 3.20 – Demolition Operation along South Lake Shore

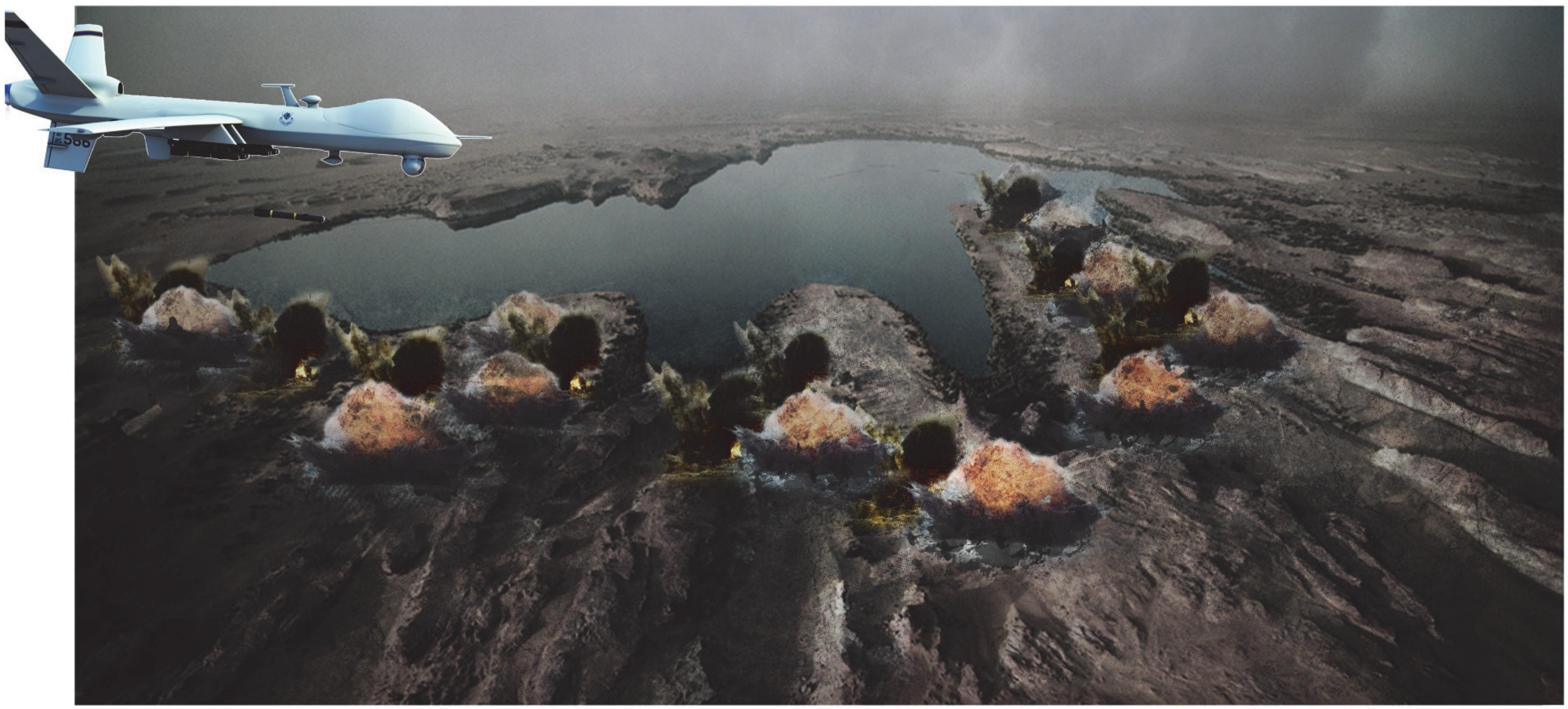


Figure 3.21 - Detonation Process

Figure 3.22 - Vigorous Lake Chad

CHAPTER 4 CONCLUSION

The two applications of bomb detonation proposed in this thesis explore the possibilities of destructive power redirected to productive purposes, speculating about concrete steps and application areas as well as conceivable outcomes.

General William Tecumseh Sherman once said, “War is hell” (Closmann 2009). In the context of war, weapons are definite devils: destroying, erasing, traumatizing, and killing. Although the idea proposed here, modifying and improving landscape by using bomb detonation, might at first sound ironic and implausible, it could be pursued reasonably in a precisely-controlled situation. It is actually more economical and efficient compared to conventional civil engineering processes. Given the spectacular destructive potential of redundant weapons, this thesis presents an ambitious story, turning the “war is hell” idea on its head by repurposing weapons for reforming, recreating, regaining, and revitalizing. This idea meets a turbulent world with a distinctive peace-oriented agenda, and aims to define a reasonable and compelling approach for present purposes, including but not limited to urban renewal and regional landscape restoration.

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